Power Engineering

JULY, 1953

Volume 57, No. 7 Circulation of this issue 32,180

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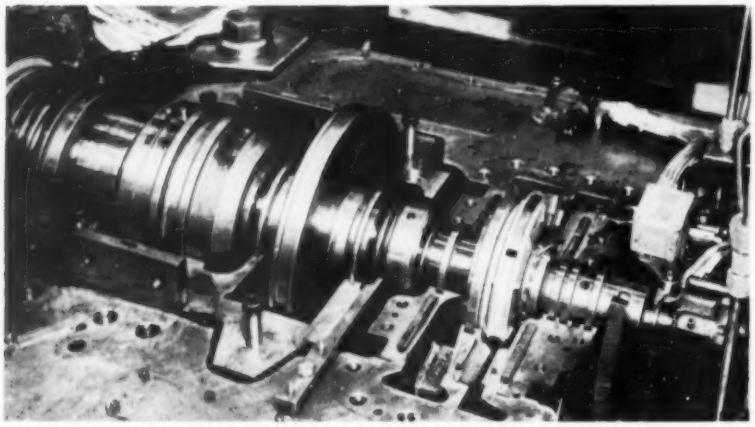
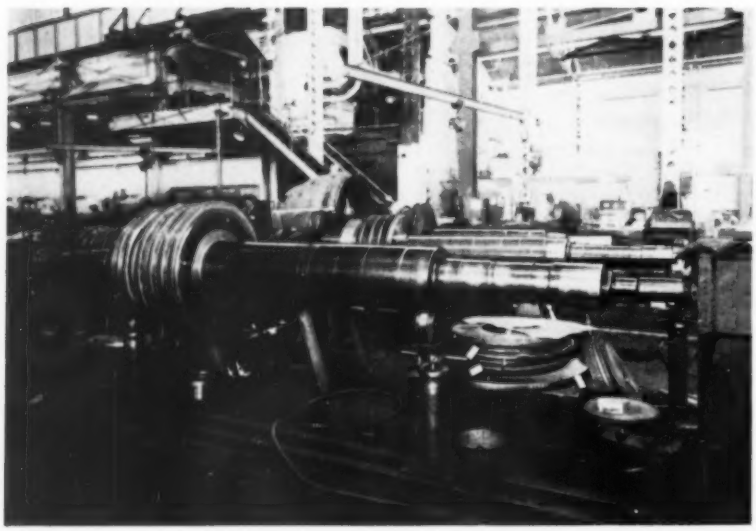
TECHNICAL PUBLISHING COMPANY • CHICAGO, ILLINOIS

In a turbine alignment is everything. At left the initial factory alignment of bearings, shaft seals, and diaphragms is being checked and recorded so that it can be reproduced in the field, and design clearances established on assembly are maintained in operation.

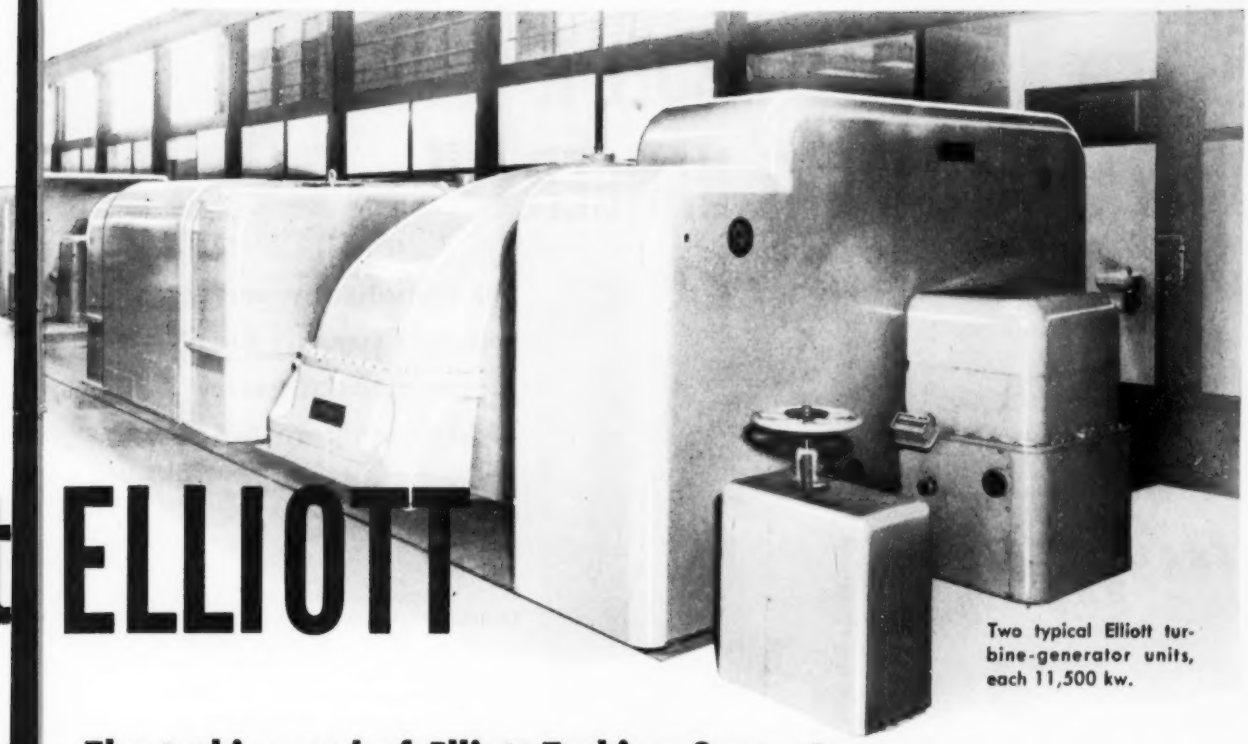
They build them well at



The steam end bearing case is arranged as a sliding pedestal to take up axial expansion. It carries the No. 1 bearing, thrust bearing, shaft-mounted main oil pump, overspeed trip pin, and speed governor. The centrifugal oil pump at 3600 rpm provides the reserve needed by the hydraulic control system, including sudden demands for large quantities of oil to move the valve servo motor on sudden load changes.



In turbine rotors initial temperature shocks in the first stages cause faster expansion in the disc than in the shaft. This would tend to relieve a shrink fit, thus upstream wheels for Elliott large, high-temperature turbines are forged integral with the shaft. In later stages temperature changes in disc and shaft are more nearly uniform, and the problem is replaced by that of higher stress due to the larger diameters and heavier blading. This increased physical stress is met by using special alloy discs shrunk on the shaft. Such individual discs have higher physicals than can be obtained in the large shaft forging and are therefore best suited to the higher blade loads, and with the low temperatures in these down-stream stages temperature changes do not affect the shrink fit.



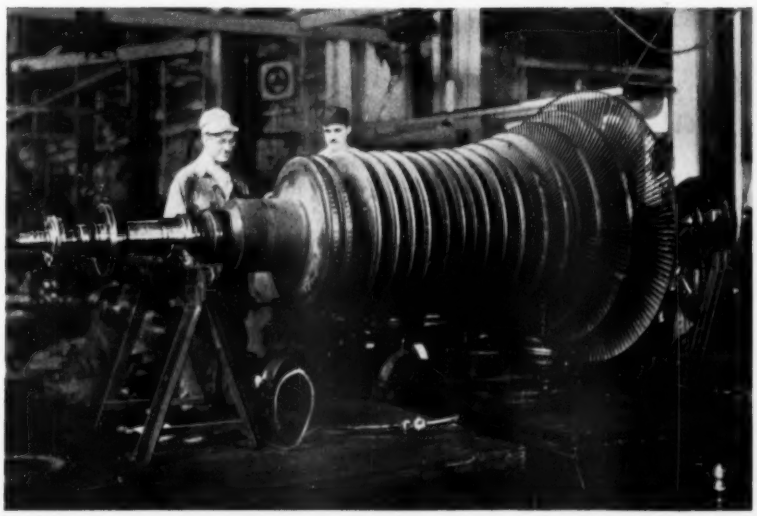
ELLIOTT

Two typical Elliott turbine-generator units, each 11,500 kw.

The turbine end of Elliott Turbine-Generators exemplifies the extreme care and high degree of engineering skill that has become known as characteristically Elliott. Look over the pictures on these two pages—they speak for themselves. For full data on completely Elliott-built turbine-generators, contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

ELLIOTT Company
Steam Turbine Dept.

With the many physical and chemical checks on material going into the finished rotor, is the final inspection after the shake-down run at speed and overspeed on the test block. While material control during each step in manufacture minimizes the hazard of test operational failure, the final proof of the rotor lies in black light inspection for cracks in shrouding and other parts.



H3 3

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The New GRINNELL MODEL R CONSTANT SUPPORT HANGER

FEATURES OF GRINNELL MODEL R CONSTANT SUPPORT HANGER:

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- Requires less head room
- Can be bolted directly to the building structure or suspended by either single or double rods

SEND FOR DETAILED CATALOG ON NEW GRINNELL MODEL R CONSTANT SUPPORT HANGER

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If conditions require a change of supporting force, a load scale is provided so that accurate field adjustments of at least plus or minus 10% may be made by turning a *single* load adjusting bolt. Wherever the adjustment is set, the Model R gives a load deflection curve that is a straight horizontal line.

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Subscription Information—Published Monthly. Price: United States and Possessions $10, Canada $11, one year. Other countries $12.....Single copies $1.00.

Microfilm Edition, $4.75 one year; from University Microfilms, Inc., Ann Arbor, Mich.

NBP *Indexed in the Industrial Arts Index and the Engineering Index on file in Public Libraries*

ECA *Acceptance under Section 34.64 P. L. & R., authorized. Publication office, Concord, N. H.*

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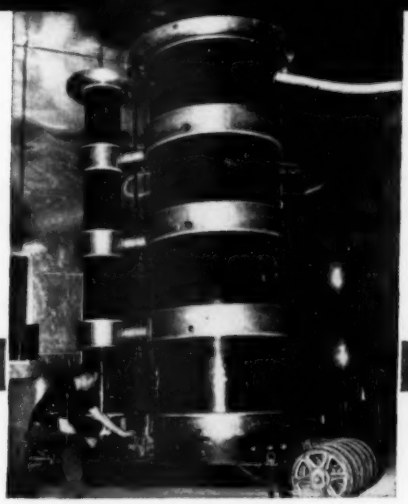
JULY 1953
VOL. 57 • NO. 7



Better insulation for transmission may result from the use of this GE 500,000-v generator

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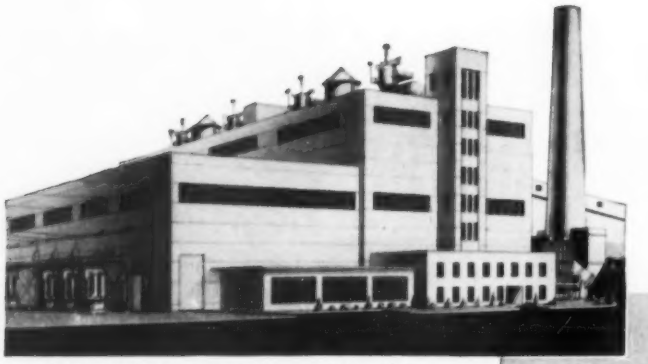
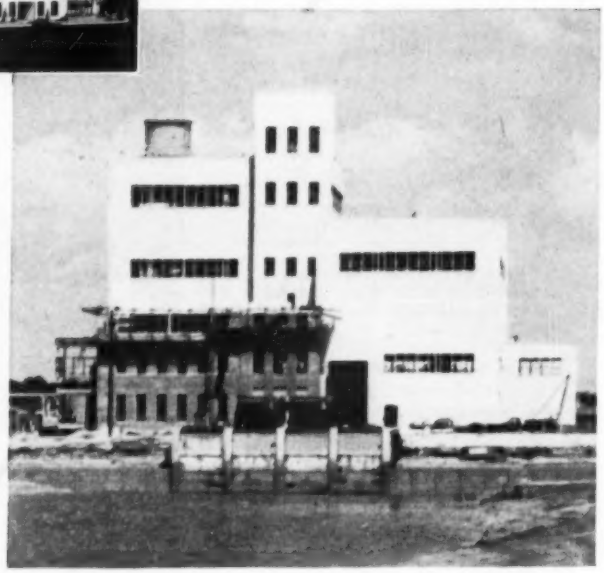
The only magazine devoted exclusively to the job interests of power engineers



Yates Plant at Whitesburg, Georgia, was dedicated in October, 1952.

Oh, I see

McManus Plant near Brunswick, Georgia, went into service in November, 1952.



Hammond Plant near Rome, Georgia, will go into service late in 1953.

...they're using our valves at Georgia Power

Newest in their growing chain of giant power plants for expanding service in Georgia are these three plants. Indicative of their builders' desire to assure maximum dependability is their selection of OIC Valves for these plants.

Every OIC Valve is *precision-engineered* and *precision-made* to give longer, trouble-free service at no extra cost to you. OIC offers *precision-application help* in selecting valves best suited to each job.

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ENGINEERS' PREVIEW

EIGHTEEN OF THE world's largest circuit breakers, each with an interrupting rating of 25,000,000 kva at 330 kv, will be built for the Atomic Energy Commission project near Portsmouth, Ohio, by Westinghouse. Operating in connection with sensitive relaying equipment, the breakers will automatically remove short circuits or faults within 1/20 sec after trouble occurs. Within a third of a second, when so desired, the breaker will reclose, re-establishing service if the fault has disappeared.

The giant oil-breaker resembles an over-sized watch case 26 ft high.

* * *

BUGS HELP MAKE iron and steel? Fantastic, you say. But not according to the American Iron and Steel Institute, which maintains that iron and steel are very directly associated with a form of actual life — iron-depositing organisms that help to make some kinds of iron ore.

The best known of the so-called iron bacteria and other organisms is the *bacterium Leptothrix ochracea*, which appears to be capable of self-nourishment on inorganic compounds. These microscopic "bugs" were very busy in prehistoric times helping to form rich deposits of "bog" iron ore, or limonite, to be used by man millions of years later. They are still found today, although relatively scarce. Their importance to the iron and steel industry has greatly diminished, due to the fact that the nation's great ore deposits now in use were formed by other processes.

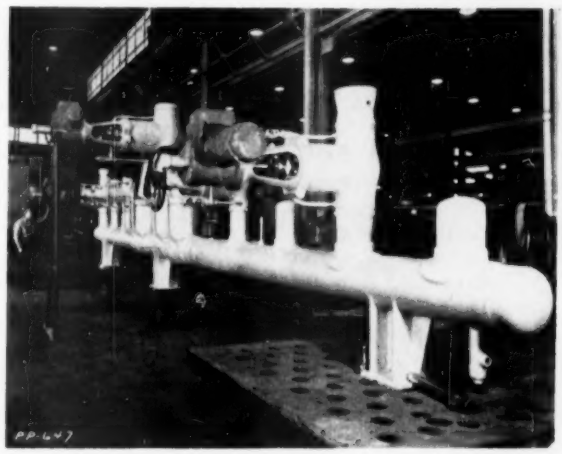
The *leptothrix bacterium* does not create iron, but "processes" it. Living in iron-containing water, it absorbs the iron from the water and deposits it as insoluble ferric hydroxide. This oxide forms an iridescent scum of ocher on the surface, familiar to everyone in wayside ditches. The oxide then sinks to the bottom, ultimately to form bog iron ore.

* * *

FOR MANY YEARS, engineers have been working on various processes for producing various gasses from coal, but now a new process has been announced whereby pulverized coal is converted in one step to synthesis gas, a mixture of carbon monoxide and hydrogen which is the base of over 100 of the world's most important chemicals.

This was explained recently before the American Gas Association by Paul Grossman of the Research and Development Center of the Babcock & Wilcox Company. The new process, it is claimed, will produce the gas much more economically than the old method.

First pilot plant for the new gasifying process was built by B&W for the Bureau of Mines and went into operation at Morgantown, W. Va. in the summer of 1951. They have burned about 500 lb of coal per hour and produced 330,000 cu ft of carbon monoxide and hydrogen gas per day. Then, in the Fall of 1951, a larger size plant was built for du Pont at their Belle, W. Va., works and this plant converted 3000 lb of coal per hr into gas, producing over 2,000,000 cu ft per day. Now du Pont has placed an order for a full scale plant with B&W, scheduled for operation next year.



Fabricated in the Blaw-Knox shops, this steam header is part of piping for the power plant of Ohio Works of U. S. Steel Corporation, Youngstown, Ohio.

MODERN SCULPTURE? CERTAINLY modern and, in a way, sculpture, for it is a mammoth steam header that Blaw-Knox Company's Power Piping and Sprinkler Division is furnishing as part of the complete piping for an addition to power facilities at the Ohio Works of U. S. Steel Corp. in Youngstown, Ohio.

This steam header, which is 36½ ft long over all and weighs 10½ tons, is claimed to be one of the largest ever built.

Two boilers, equipped with automatic controls, feed steam into the header which sends it to the generating units and to a reducing station for the boiler auxiliaries and the existing 280 psi power plant steam system. Piping to the turbine generator is 14 in. in diameter and has a wall thickness of 0.937 in. The piping system is designed to handle steam at 950 psi, 900 F and besides supplying and erecting the piping Blaw-Knox is erecting an 18,750 kva turbine generator and all its auxiliaries.

* * *

NATIONAL SCIENCE FOUNDATION has moved to a new location at 1520 H. Street, N. W., Washington 25, D. C. The new headquarters are in the *old* "Cosmos Club" building recently taken over and renovated by the General Services Administration. The new telephone number is STerling 3-2140. The Government Telephone Code is 1224. The Government Messenger Service code remains Stop 19. There is no change in the Western Union desk-fax call letters QBM. The mailing address will continue to be National Science Foundation, Washington 25, D. C.

* * *

EVER HAVE FLIES around your power house? How many? You say, "Who cares?" And also, even if anybody did care, how would they find out how many?

Well, a very simple and ingenious way of counting flies has been used as part of some very scientific tests on evaluation of insecticides, which have opened the way for development of modern fly sprays. If you're interested either in the fly counting or the fly killing, read all about it in the March-April issue of the Rohm & Haas *Reporter*.

WHAT THE WORLD needs, say some of our power engineer friends, is fewer and better people — not more people. But that is not what it is getting. Consider the populations of India, China, and Africa.

Opposed to the idea that we need fewer and better people are the opinions of many competent men who recognize that Malthus was right. He said, a hundred years or so ago, that the population of the world would increase faster than its ability to feed itself. But the opponents counter that with the argument that, by proper use of science and technology, we can substitute our mechanical technology for the old hand technology that could not support the world and, by means of that mechanical technology, increase the world's production of all it needs to support the increasing populations. And that with a standard of living far beyond anything they ever dreamed possible.

How we are doing that in this country was well shown by our article on the relation of power development to population growth in the United States, POWER ENGINEERING, January 1953 issue.

However, in all this turmoil of increasing populations, we now are told that the population of Canada is still far too small in relation to the industry it has created and the condition becomes more and more pressing with the almost daily discovery of new natural resources. This was pointed out by H. G. Hilton, president of the Steel Company of Canada, Ltd., before the American Iron and Steel Institute meeting. He asserted the future of Canada is bright and pointed out that his country has expanded its capacity 110 per cent in the steel industry since 1939. He said "We need every Canadian we can produce and many more people besides" and advanced the idea, which will shock many of our professional patriots, that young Americans should be encouraged to move to Canada. After eating some of the marvelous steaks and other succulent viands we have been able to get in Canada and observing the magnificent scenery as well as the new industrial developments there, we wonder if Mr. Hilton may not have a point.

* * *

ONE OF THE world's smallest railroad systems, after 13 years of continuous operation, will be closed down for a period of several months with all freight and passenger service suspended.

It is expected that no serious hardship to the public will result during this time, while the railroad replaces all of its main line trackage and adds a modernized freight-marshalling yard with completely electronic controls for efficient operation.

As a matter of fact, only visitors to Chicago's Museum of Science and Industry will realize the work is going on, for this is where the railroad operates. It's the Museum and Santa Fe Railroad, which shows in miniature the large-scale operations of an entire railway system on 613 ft of main line track.

* * *

J. PERRY YATES, senior vice president of Bechtel Corp., has been elected a director of the Atomic Industrial Forum, Inc. The Forum was established in April as an association of businessmen, engineers, scientists, educators and others interested in the non-military development and use of atomic energy.

Mr. Yates directs Bechtel Corp. activities in the field of power engineering and construction.

WHO ARE THE gloom vendors of America's future? We hope you are not one of them, for they were denounced by U. S. Steel Vice-Chairman Roger M. Blough recently before the graduating class at Susquehanna University in Pennsylvania.

"As the self-appointed guardians of a nostalgic past, which is dead as a doornail, we cry out in anguish about the wars and all manner of other worries", said Mr. Blough. "But I think we cry in vain. The world is inching forward, drawn by its own inward strength, physically, morally and spiritually. Your youthful eyes can discern it and you can be part of that ceaseless movement if you but will it." Mr. Blough documented his optimism for the future by citing examples from every industry, from aluminum and atomic energy to zirconium, to show how the world is continuing to move forward and confound the gloom vendors. Industry, he said, and especially the steel industry, is a typical challenge that American youth is destined to answer.

* * *

ELECTRIC UTILITY engineering must be made more appealing to college graduates if the industry is to forestall a shortage of future leadership that could injure the nation, H. N. Muller, Jr., assistant to the vice-president in charge of engineering for the Westinghouse Electric Corporation said recently.

Electricity provides the muscles basic to the success of all industry, and unless utilities provide today for their leaders of tomorrow, the consequences will be felt throughout industry and even by the nation itself.

Mr. Muller suggested that utilities offer an aggressive program of training and continued education to interest young engineers in power engineering and help them become productive employes more quickly.

* * *

INTERNATIONAL NICKEL CO. of Canada, Ltd. has signed a contract under which the United States Government has purchased, for quick delivery, a total of 120,000,000 lb of metallic nickel and 100,000,000 lb of electrolytic copper, deliveries to start this December.

* * *

ALTHOUGH power engineers will not need to worry much about it in the immediate future, a time will come, according to all the best available evidence, when our natural solid, liquid and gaseous fuel resources will be exhausted, and there is even a possibility that the resources of fissionable materials for a generation of atomic power also may be exhausted.

When that time does come, the human race may have to look to the wind, tides and especially to solar energy for the power it will need.

Accordingly, it is the duty of both science and engineering to do what it can to prepare as much information as possible on which to build that solar energy conversion in the future. So the National Science Foundation has announced a grant of $6,000.00 to the University of Wisconsin, at Madison, Wisc., for joint support of a scientific conference on solar energy and its utilization to be held September 12 to 14, 1953. Farrington Daniels, professor of physical chemistry, University of Wisconsin, Madison, Wisc., is chairman of this conference and full information can be obtained either from him or from the National Science Foundation at its new address, 1520 H. Street N.W., Washington 25, D. C.

Eliminate the Danger of

INTERCRYSTALLINE CORROSION

ALLIS-CHALMERS WATER CONDITIONING
Equipment — Chemicals — Service

Photomicrograph of edge of crack caused by intercrystalline corrosion. U. S. Bureau of Mines detection unit (inset) tests for causes of intercrystalline corrosion.

Dangerous and costly cracks due to intercrystalline corrosion (embrittlement) will be no problem in your boilers if you have given careful consideration to the problem *in advance*. You can get the information you need to analyze your operations from Allis-Chalmers water conditioning Bulletin 45. It explains intercrystalline corrosion — the cause of embrittlement. It tells what tests are necessary to recognize this condition. And it discusses what you can do.

Get the Answer to Many Problems

Bulletin 45 is one of a series of Allis-Chalmers bulletins on water conditioning problems. Like all of these useful bulletins, it is based on the wide experience of Allis-Chalmers water conditioning men in handling water problems for nearly every industry. In addition, it is based on Allis-Chalmers long experience building turbines and power plant equipment.

Complete Service Available

Allis-Chalmers gives you complete water conditioning service. You can get analyses and reports on your problems. You can get the chemicals needed in all water treatments. And you can get the equipment for any system.

A-4014

For your copy of Bulletin 45 on intercrystalline corrosion, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby Allis-Chalmers district office and have an Allis-Chalmers representative consult with you on your water problems.

ALLIS-CHALMERS

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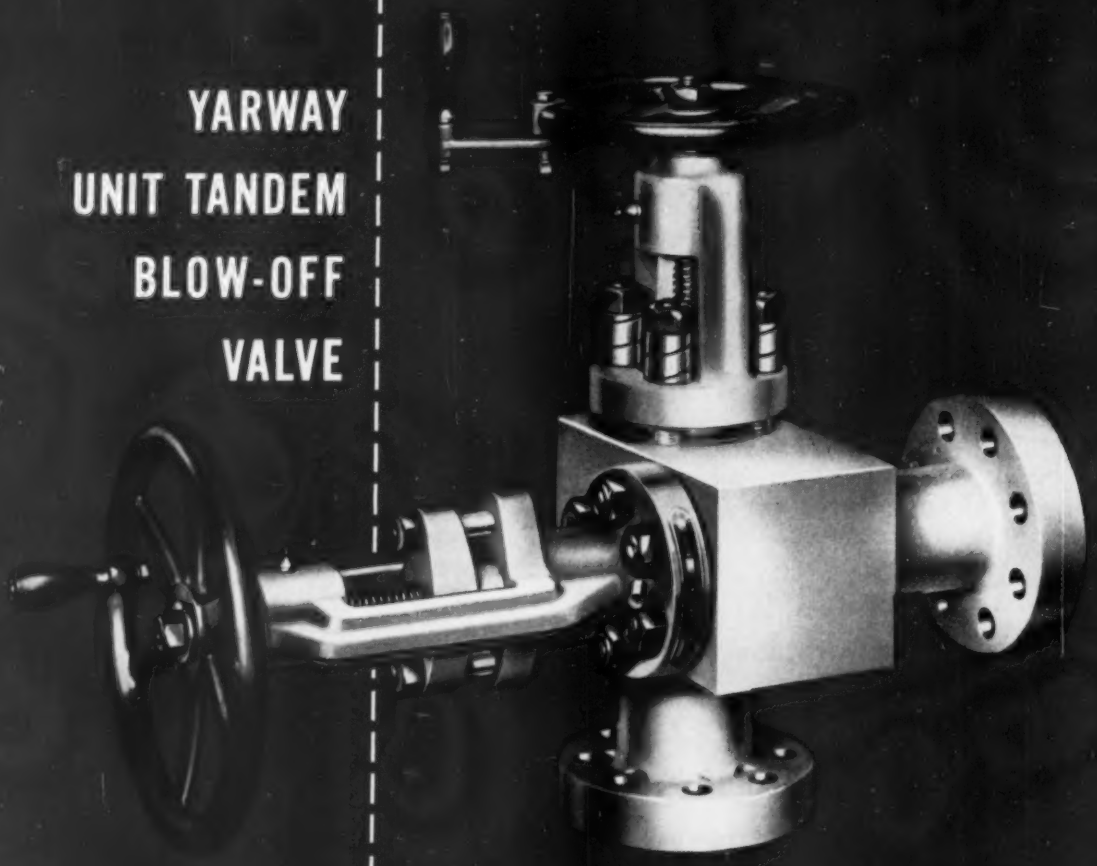
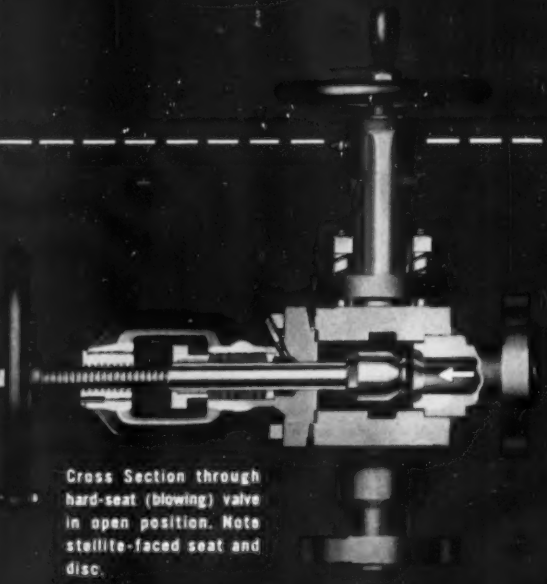
YARWAY UNIT TANDEM BLOW-OFF VALVE

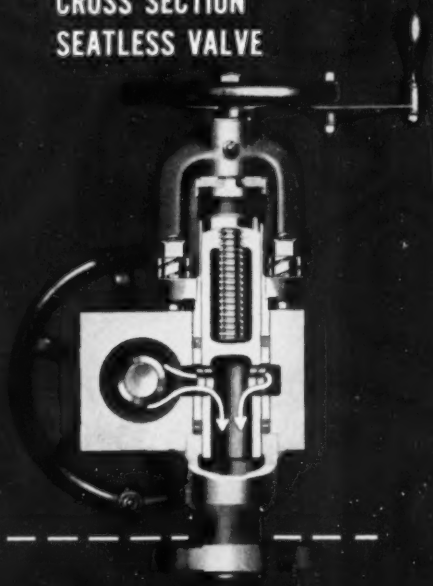


CROSS SECTION HARD-SEAT VALVE



Cross Section through hard-seat (blowing) valve in open position. Note stellite-faced seat and disc.

CROSS SECTION
SEATLESS VALVE



Cross Section through seatless (sealing) valve in open position. (On pressures over 1500 psi two hard seat valves are recommended.)

RUGGEDNESS
...WHERE YOU NEED IT

A one-piece forged steel block serves as the common body for both valves in Yarway Unit Tandem Blow-Off Valves.

You get rugged strength where you need it... added protection for your high pressure boilers.

Whether in times of emergency, normal blow-down service, or acid washing, this high safety factor is a source of satisfaction to boiler plant operators.

Yarway Unit Tandems combine all advancements of modern metallurgy with experienced design and skilled workmanship. The result—DEPENDABLE PROTECTION.

POSITIVE ACTION
...WHEN YOU NEED IT

When putting high pressure boilers on the line, or in times of emergency, you need positive action at the blow-off valves.

With Yarways you have it.

Both the hard seat-seatless combinations and the hard seat-hard seat combinations provide positive opening and closing with drop-tight shut-off. Open yokes permit visual indication of the disc position in the hard seat valve and of the plunger in the seatless valve.

These are some of the reasons why *more than 4 out of every 5 high pressure plants in the United States are Yarway-equipped . . and* among boiler plants of all pressures, *more than 16,000 are Yarway-equipped*

Write for your free copy of Yarway Blow-Off Valve Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

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blow-off valves

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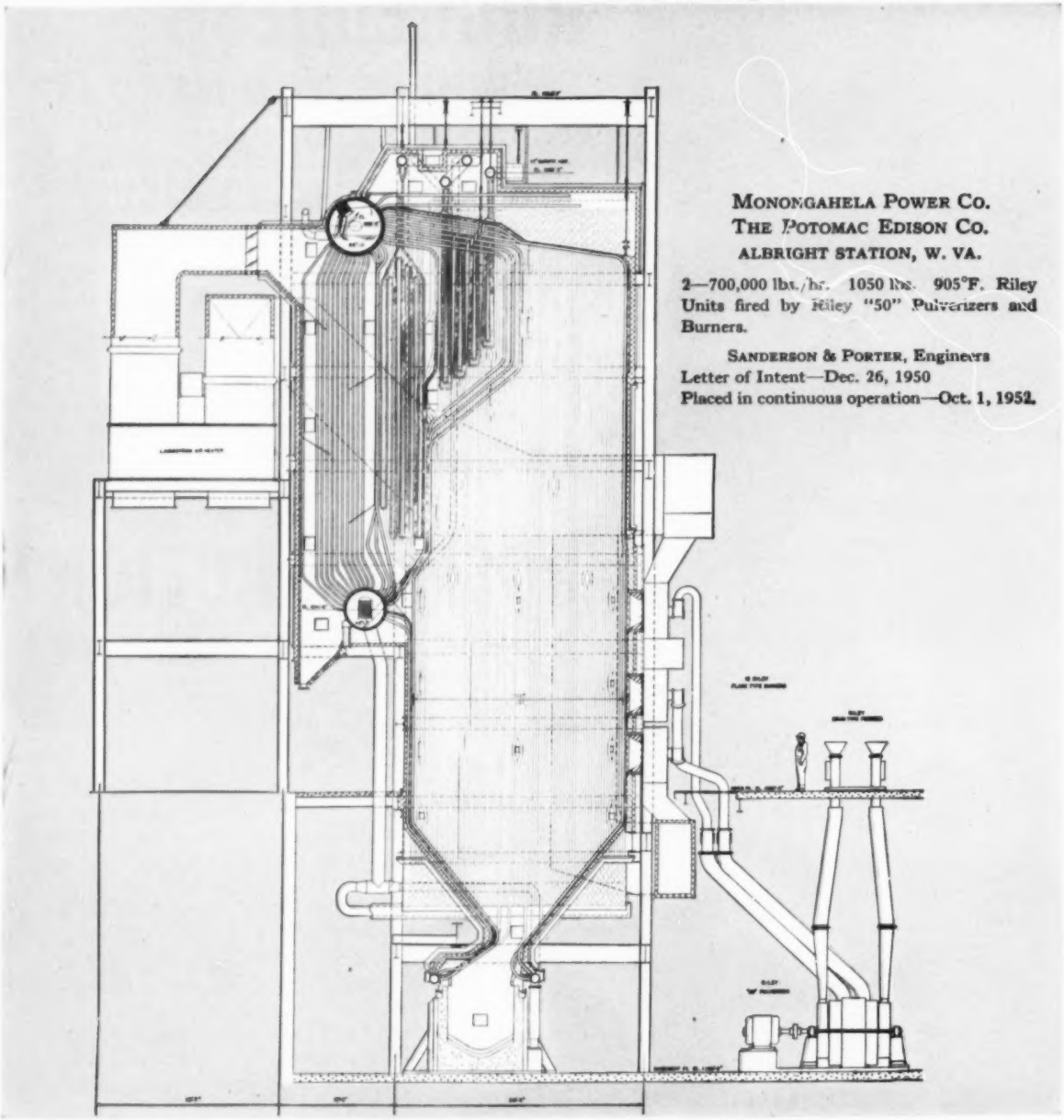

MONONGAHELA POWER CO.
THE POTOMAC EDISON CO.
ALBRIGHT STATION, W. VA.

2—700,000 lbs./hr. 1050 lbs. 905°F. Riley Units fired by Riley "50" Pulverizers and Burners.

SANDERSON & PORTER, Engineers
Letter of Intent—Dec. 26, 1950
Placed in continuous operation—Oct. 1, 1952.

TRADE MARK Rx REGISTERED

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Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
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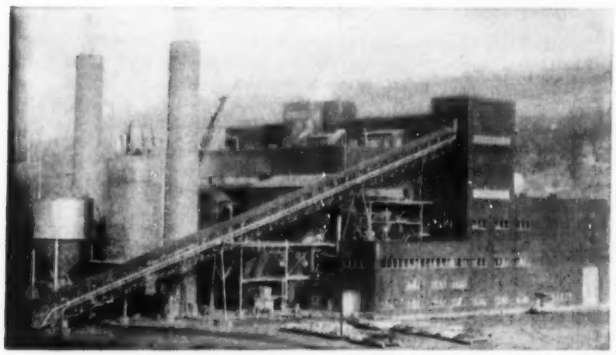
Albright Station go on the line

21 months after letter of intent

A letter of intent dated December 26, 1950 was given Riley Stoker Corporation by Monongahela Power Co. and The Potomac Edison Company covering the first two 700,000 lbs./hr. units for their new Albright Station. In spite of the fact that this was a completely new station and the difficulties in procurement of materials, the first unit was placed in continuous operation October 1, 1952, only 21 months after date of award, performing as guaranteed and predicted, and without the necessity of shutdowns for adjustments or corrective measures.

It is because of performance like this—engineering, fabrication, erection and operation of the equipment—that so many public utilities and industrials have swung to Riley. By investigation and experience one after another has found that you can rely on Riley. Be sure to investigate Riley equipment and request a Riley proposal when considering new steam generating or fuel burning equipment. You will be glad you did so.



A Few Recent Riley Public Utility Units

TEXAS ELECTRIC SERVICE CO.
1,250,000 lbs./hr. 2125 psig, 1005°F. and 1005°F. reheat

DALLAS POWER & LIGHT CO.
1,250,000 lbs./hr. 2125 psig, 1005°F. and 1005°F. reheat

HOUSTON LIGHTING & POWER CO.
1,250,000 lbs./hr. 2125 psig, 1005°F. and 1005°F. reheat

DEPARTMENT OF WATER AND POWER CITY OF LOS ANGELES, CALIFORNIA
1,200,000 lbs./hr. 2075 psig, 1000°F. and 1000°F. reheat.

LOUISIANA POWER & LIGHT CO.
1,000,000 lbs./hr. 1725 psig, 1005°F. and 1005°F. reheat.

SOUTHWESTERN GAS & ELECTRIC CO.
630,000 lbs./hr. 1050 psig, 1005°F.

MONONGAHELA POWER CO.
700,000 lbs./hr. 1050 psig, 905°F.

UTAH POWER & LIGHT CO.
575,000 lbs./hr. 1700 psig, 1000°F. and 1000°F. reheat.

CENTRAL ILLINOIS LIGHT CO.
600,000 lbs./hr. 950 psig, 900°F.

NORTHERN STATES POWER CO.
385,000 lbs./hr. 1500 psig, 950°F.

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
460,000 lbs./hr. 1025 psig, 900°F.

THE POTOMAC EDISON CO.
700,000 lbs./hr. 1050 psig, 905°F.

IOWA ELECTRIC LIGHT & POWER CO.
300,000 lbs./hr. 975 psig, 910°F.

GULF POWER CO.
325,000 lbs./hr. 1000 psig, 900°F.

SOUTH CAROLINA GAS & ELECTRIC CO.
400,000 lbs./hr. 1475 psig, 955°F.

UTAH POWER & LIGHT CO.
620,000 lbs./hr. 1500 psig, 955°F.

IOWA-ILLINOIS GAS & ELECTRIC CO.
250,000 lbs./hr. 975 psig, 905°F.

PUBLIC SERVICE CO. OF INDIANA
400,000 lbs./hr. 1000 psig, 910°F.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

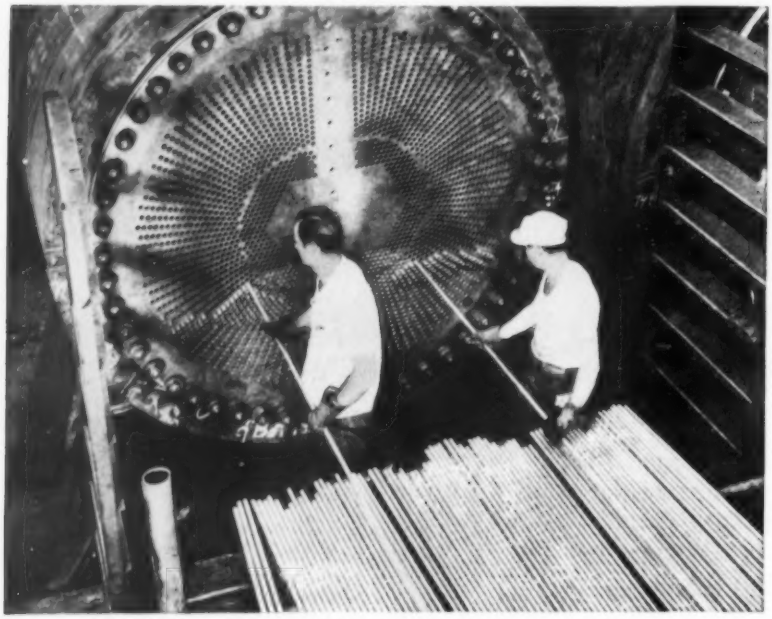
For more data circle 506 on Post Card

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND. — IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



Operators installing tubes into a Radial-Flow surface condenser—courtesy Westinghouse Electric Corporation.

The Proper Storage of Condenser Tubes

Some plants always carry a stock of tubes in order to make speedy repairs and keep shutdown time to a minimum. The benefits from such forward planning will not be fully realized if some of these tubes become damaged from improper storage.

Also improper handling may result in dents, digs, kinks, or a permanent set which predispose the tubing to premature failure. In the case of dents, water impinging on the bumps inside the tubes may cut through the protective film at that point and thin the wall locally until eventually perforation occurs.

Damp Warehouses Unsatisfactory

Storage in damp warehouses subject to a wide range of temperatures is undesirable. Setting cases of tubes on wet floors or wet ground should be avoided because they absorb and retain moisture. White, green, blue, and black salts and red and black oxides form on tubes in contact with the wet walls of wooden cases. Condensation of moisture leads to surface corrosion and cracking because the condensate remains as a thin film of water for a long period without drying out or evaporating. This film may absorb gases from the atmosphere and may become quite concentrated with time. This corrosive water film has in some instances led to very severe corrosion.

On the other hand, tubes stored in dry, clean, well-aired warehouses will quickly lose the film of condensate, and do not deteriorate although they may darken in color with time.

Effects of Outdoor Storage

Outdoor storage may lead to the accumulation of dust, cinders, and soot which together with rain, snow, and condensation produce serious corrosion on the outside surface and the ends of the tubes. Covering with a tarpaulin should be arranged in the form of a tent with vents at the peak to permit free circulation of air and thereby keep dampness to a minimum. The combined action of high humidity and certain contaminants in the atmosphere, such as ammonia, may produce season cracking especially if the storage period is extended.

Since a certain percentage of tubes may be subject to failure if stored for long periods under unfavorable conditions, trouble may develop if such tubes are used for making emergency repairs. To prevent such an occurrence, some operators make a laboratory examination of stored tubes periodically to determine if they are undergoing serious attack from corrosion or are showing signs of stress corrosion cracking.

Bridgeport recognizes the importance of protecting tubes in handling and in transit. They are carefully packed in wooden cases to arrive in perfect condition. The same care should be used by operators in handling and storing tubes.

Recommendations for Proper Storage

(1) Keep tubes in cases, flat until ready for use—but don't stack too high to avoid crushing of bottom cases.

(2) Select a dry, protected storage location not subject to extremes of humidity and temperature. A hot, dry location is best. If necessary, dehumidify the storage area.

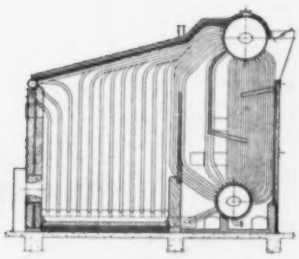
(3) Avoid outdoor storage especially where there is dirt, dampness, smoke, soot and corrosive fumes.

(4) If cases become watersoaked, both the cases and tubes should be dried out promptly.

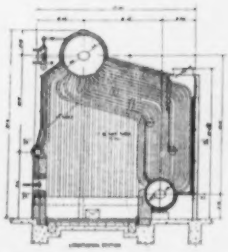
(5) If stored in racks, tubes should be supported properly.

Bridgeport's laboratory will be glad to help condenser tube users in the selection of alloys to meet existing service conditions. Get in touch with the nearest Bridgeport district office for assistance on your corrosion problems and for your condenser and heat exchanger tube requirements. (9892)

For more data circle 507 on Post Card



2 Drum Water Tube Boiler



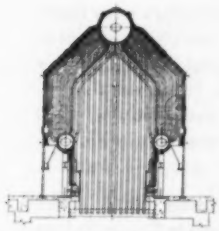
Type-S 2 Drum Boiler Series 51

FOR ALL INDUSTRY . . .

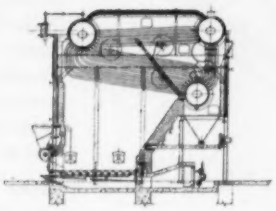
WICKES

STEAM GENERATORS

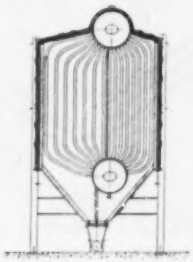
• In the oil, paper and chemical industries and in manufacturing plants, institutions and public buildings throughout the world Wickes Steam Generators are in constant daily service. All types, such as those illustrated on this page, with capacities up to 250,000 lbs. steam per hour and 1000 psi. Write for descriptive literature.



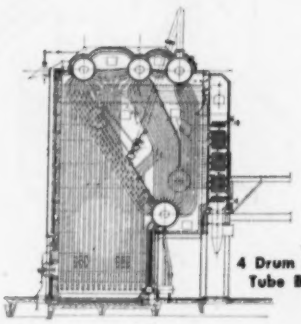
"A" Type Water Tube Boiler



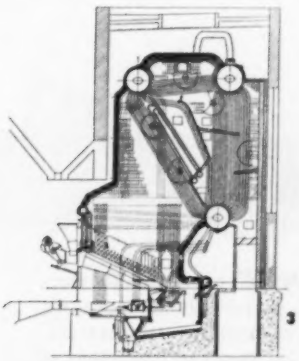
3 Drum Low Head Water Tube Boiler



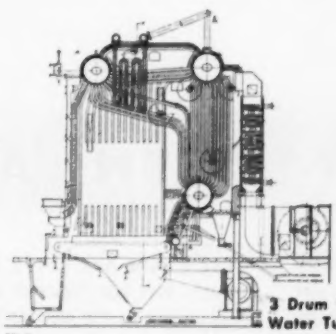
Wickes 2 Drum
Waste Heat Installation



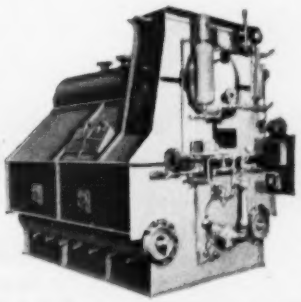
4 Drum Water
Tube Boiler



3 Drum Water
Tube Boiler



3 Drum "B" Type
Water Tube Boiler

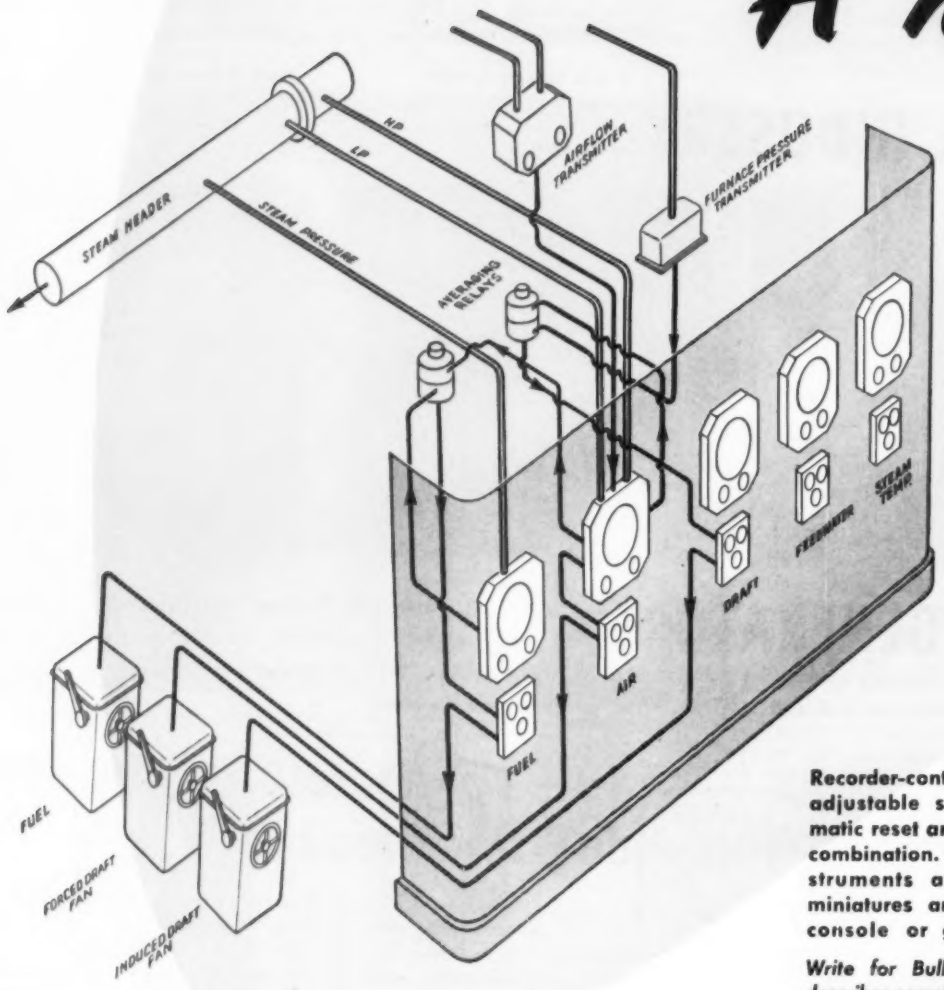


Type "A" "Packaged" Steam Generator

THE WICKES BOILER COMPANY • DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

RECOGNIZED QUALITY SINCE 1854 • SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

A new



Recorder-controllers may have adjustable sensitivity, automatic reset and pre-act in any combination. Standard size instruments are shown, but miniatures are available for console or graphic panels.

Write for Bulletin 1007 which describes complete Copes-Vulcan Boiler Control.

WHAT'S IN A NAME?

COPES has for half a century specialized in the control of boiler feed water flow and pressure, boiler water level—and, more recently, boiler steam temperature.

VULCAN has since 1903 brought soot blowing from an act of drudgery to the ease and convenience of pushing a button at a centrally located control panel.

Taylor has for over 100 years led in instruments for measuring and controlling temperature, pressure, flow and liquid level in the process and power fields.

formula...

C·V+T=BBC

COPES·VULCAN+*Taylor*=BETTER BOILER CONTROL

This new formula gives you a fresh approach to boiler control.

Copes contributes experience with flow, level, pressure and boiler steam temperature. *Vulcan* provides an intimate knowledge of high-pressure, high-temperature steam generators. *Taylor* adds instrumentation of unequalled responsiveness and accuracy.

The result is *Better Boiler Control* —combining combustion, feed water, steam temperature and boiler cleaning in a *system* especially designed for your needs.

And Copes-Vulcan assumes full responsibility — from analysis of your conditions through on-the-job service for the life of the installation.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

COPES VULCAN **BOILER CONTROL**

WITH INSTRUMENTATION

BY *Taylor*

For more data circle 509 on Post Card

Could You Use SAVINGS *Like These?*

40% less
Fuel Consumption
50% more
Boiler Capacity

Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

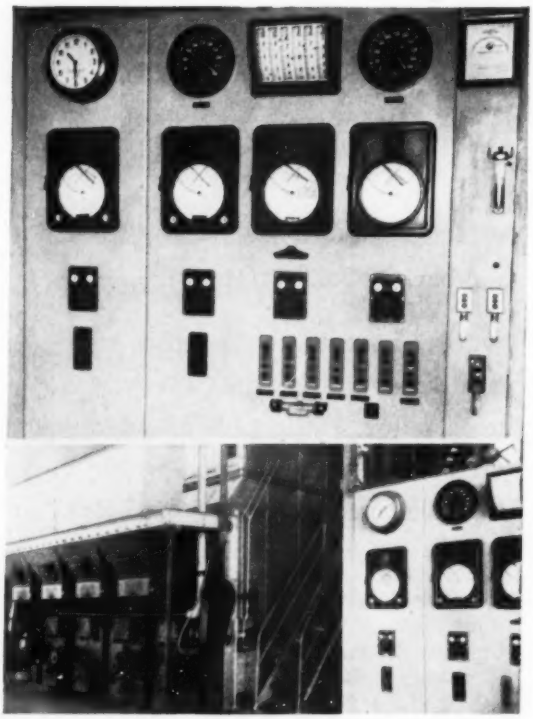
The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

Here's where Kerr Bleaching & Finishing Works has cut operating costs—by installing *co-ordinated* Bailey Meters and Controls. The installation includes Bailey Meter Combustion Control, and Bailey Two-element Feed Water Control.

Such a co-ordinated system is an important plus for Bailey customers. Nowhere else can you buy such a complete range of equipment, selected without bias to do the best job for you. Nowhere else can you find such expert engineering service, immediately available through conveniently located direct sales and service representation. May we help you?

Call our local branch office or write for Bulletin 15-H.

A-113



Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

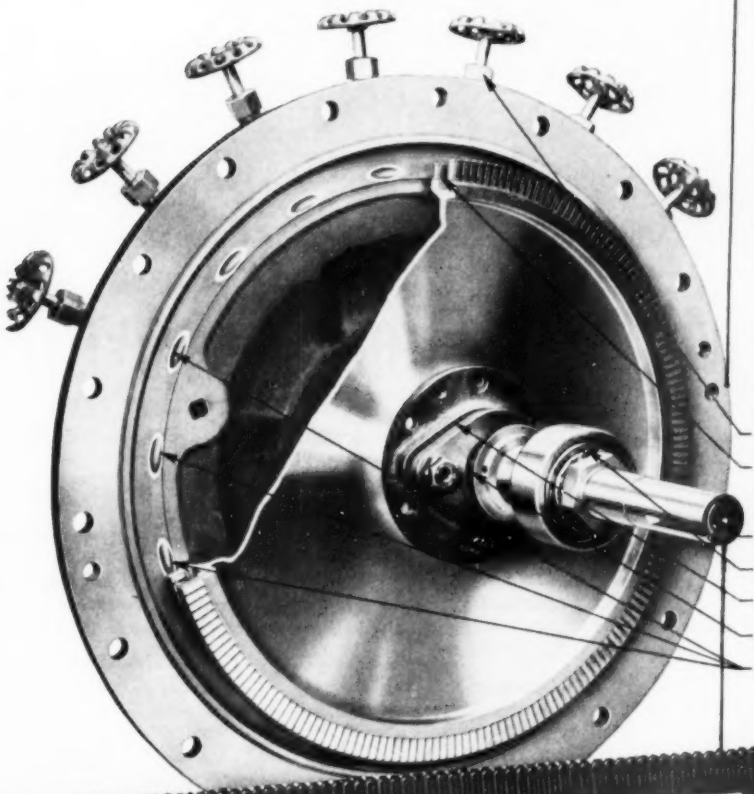
Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

For more data circle 510 on Post Card

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



- 7 hand valves for efficient partial load operation, (20" turbine shown)
- 2 row velocity-stage turbine wheel with stainless steel turbine buckets — statically and dynamically balanced
- 30-40 carbon steel shaft
- Oversized double row deep grooved ball bearing
- Stuffing box with metallic packing ring
- Heavy chrome plating of shaft through stuffing box
- 3 nozzles always open

Coppus Steam Turbines, Type TF, driving chemical transfer pumps at Celanese Corporation of America's Chemcel Plant

Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes

MAKE TURBINE DOLLARS GO FARTHER

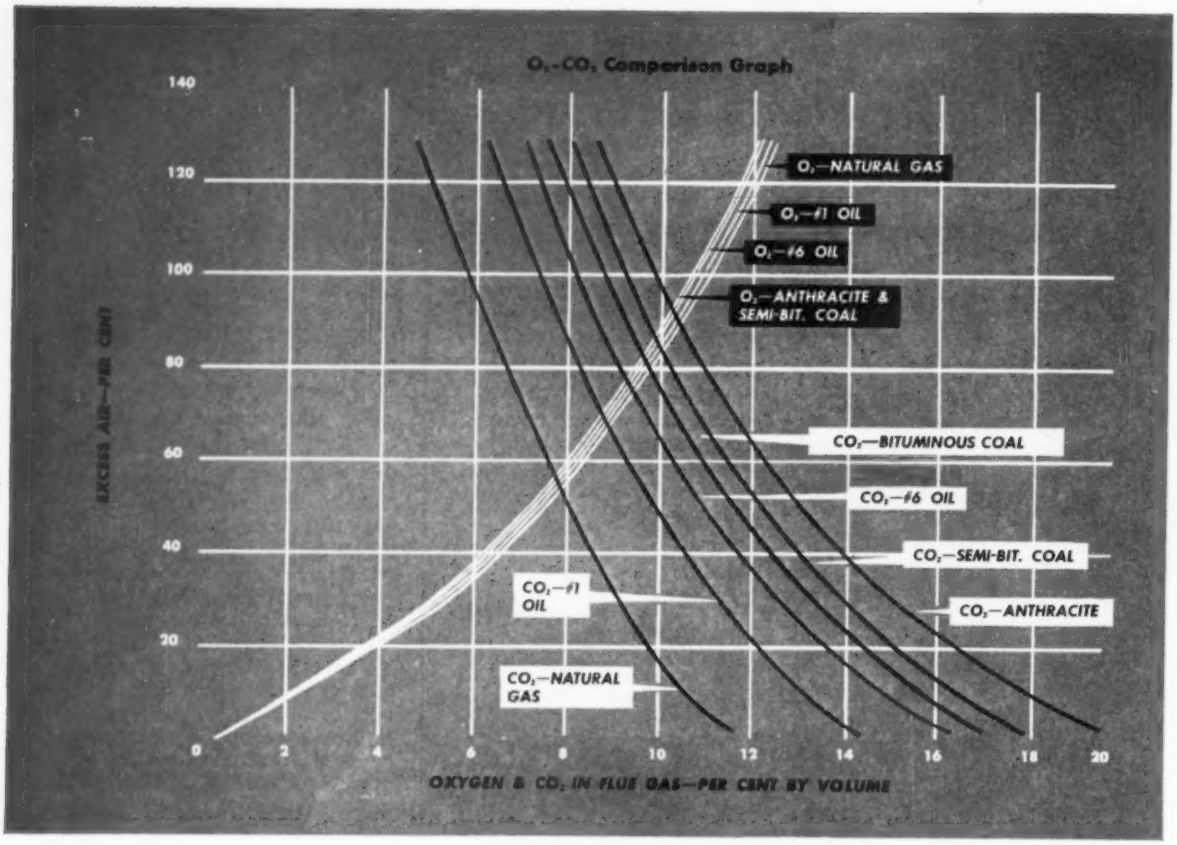
Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORP.,
167 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES

For more data circle 511 on Post Card



HOW TO BURN **Multiple Fuels** EFFICIENTLY

When switching from one fuel to another or burning more than one fuel at the same time, you can realize large savings with a continuous indication of Oxygen content in your flue gas—because Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

This fact is borne out by the graph showing the relationship of excess air to CO_2 and O_2 in the flue gas of five common fuels. While the O_2 curves nearly coincide (especially in the important 30% excess air range) the CO_2 curves diverge widely.

Large savings possible

This deviation was costing a medium sized refinery in Michigan $35-40 per day in boiler room fuel costs. Burning a combination of oil and gas they found that a combustion control system to handle their multiple fuel firing conditions would cost more than their small boilers.

With the purchase of a Hays Magno-Therm Oxygen Recorder, they found that they were able to reduce fuel costs enough *to pay for the instrument in 40 days.*

Oxygen and Oxygen alone gives you an undistorted picture of the amount of excess air present.

If you are facing the problem of multiple fuel combustion, you will want a detailed copy of this O_2-CO_2 Comparison Graph as well as Hays Bulletin 52-829-56 — describing the Magno-Therm Oxygen Recorder. Write for this free information.

With the Hays Magno-Therm Oxygen Recorder you get:

- *Continuous, highly accurate indication and recording.*
- *Complete compensation for temperature and pressure effects.*
- *Freedom from chemicals or hazardous fuel burning in the analyzing process.*
- *Swift, sure electronic operation.*

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Versiflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE **hays** CORPORATION

MICHIGAN CITY, 7 INDIANA

For more data circle 512 on Post Card

take a CLOSER LOOK *at*

B&W ALLOY TUBING

for high temperature applications

CARBON-MOLY • CROLOY ½ • CROLOY 1¼
CROLOY 2 • CROLOY 2¼ • CROLOY 3-M • CROLOY 5
CROLOY 5-SI • CROLOY 7 • CROLOY 9-M

All of these intermediate alloys are being used extensively in a wide variety of high temperature applications. All have earned universal acceptance and praise for giving optimum service satisfaction with economy over the years. The accompanying table shows the extensive range of temperature, pressure, corrosion, and oxidation conditions met by B&W Alloy Tubing. Technical data on these analyses is contained in Bulletin TB-6, available upon request. Call on Mr. Tubes—your nearby B&W Tube Representative—to get the benefit of the extensive tubing service he represents, on your specific applications.

CARBON-MOLY—0.50% Mo—For services to 1050F requiring higher creep strength than carbon steel with no increase in corrosion or oxidation resistance.

CROLOY ½—0.60% Cr, 0.50% Mo—For operating conditions to 1075F requiring properties superior to carbon-moly with respect to graphitization and creep strength.

CROLOY 1¼—1.25% Cr, 0.50% Mo, 0.75% Si—Economic grade good creep strength properties up to 1100F. Somewhat more corrosion resistant than chromium-free steels.

CROLOY 2—2% Cr, 0.50% Mo—Economic grade for resisting both oxidation and corrosion, with excellent high-temperature strength, up to 1150F.

CROLOY 2¼—2.25% Cr, 1.00% Mo—Exceptionally high creep strength up to 1175F for polymerization and high pressure cracking. Otherwise similar in properties and characteristics to Croloy 2.

CROLOY 3-M—3% Cr, 0.90% Mo—Somewhat better creep properties, and resistance to corrosion and oxidation up to 1175F than Croloy 2.

CROLOY 5—5% Cr, 0.50% Mo—For operating conditions up to 1200F where corrosion resistance is a primary requirement—with creep strength and oxidation resistance superior to Croloy 2.

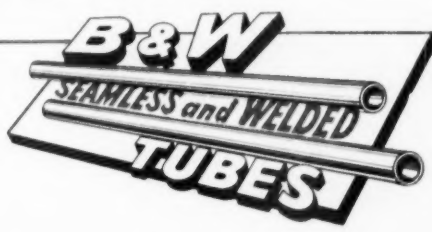
CROLOY 5-Si—5% Cr, 0.50% Mo, 1.50% Si—For operating conditions up to 1300F where oxidation resistance is a primary requirement. Excellent resistance to scaling under straight oxidizing conditions.

CROLOY 7—7% Cr, 0.50% Mo, 0.50-1.00% Si—For operating conditions up to 1250F where corrosion resistance is the primary requirement. Somewhat more oxidation resistant than Croloy 5.

CROLOY 9-M—9% Cr, 1% Mo—For severe operating conditions up to 1300F where high corrosion and oxidation resistance are essential as in hydrogenation processes.

Steels from CROLOY 1¼ upward are electric furnace alloy steels which are normally cleaner and of better quality than open hearth steels. This contributes to greater reliability and improved creep properties at elevated temperatures.

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa.—Seamless Tubing; Welded Stainless Steel Tubing
Alliance, Ohio—Welded Carbon Steel Tubing



TA-1685 (F)

For more data circle 513 on Post Card

Widest choice . . . *for engineered instrumentation*

EACH of the thousands of industrial processes presents its own peculiar problems of measurement and control. Naturally, no single instrument can solve all of these varied problems. Serious compromises would have to be made in performance, convenience, and cost.

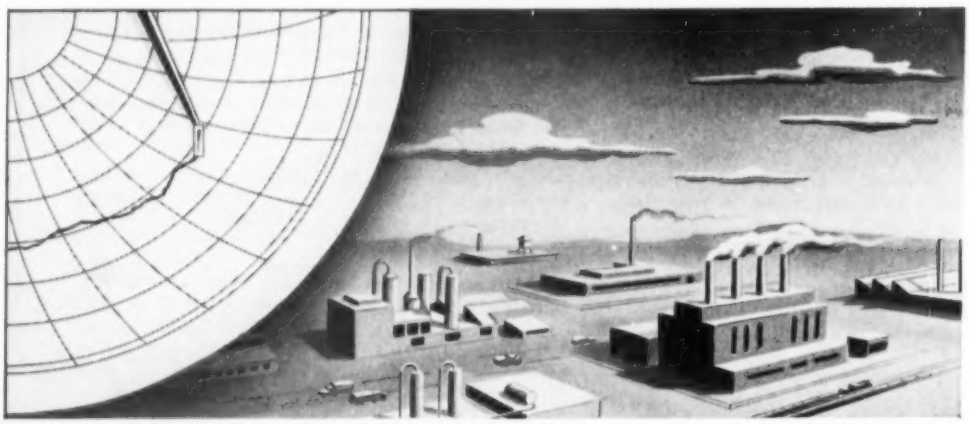
The many Honeywell primary elements, instruments, control systems, and final control elements constitute a uniquely complete family, covering practically the whole spectrum of industrial measurement and control. You can be sure that the combination selected for your job is recommended without bias, and with full consideration for every need of the application.

Included are *ElectroniK* instruments for indicating, recording and controlling a host of variables, in circular and strip chart models; *Tel-O-Set* miniature indicators, recorders and controllers; *Pyr-O-Vane* millivoltmeter controllers; square root and linear flow meters; thermometers; pressure gauges. Electric and pneumatic control systems range from the simplest to the most complex, including fully automatic program control. Primary elements include thermocouples, thermometer bulbs, *Radiamatic* elements, pH assemblies, conductivity cells, flow meter bodies and many others. For final control elements, there is a full range of motorized and diaphragm operated valves. Supplementing these are more than 7000 different non-indicating devices for controlling temperature, pressure, vacuum and other conditions.

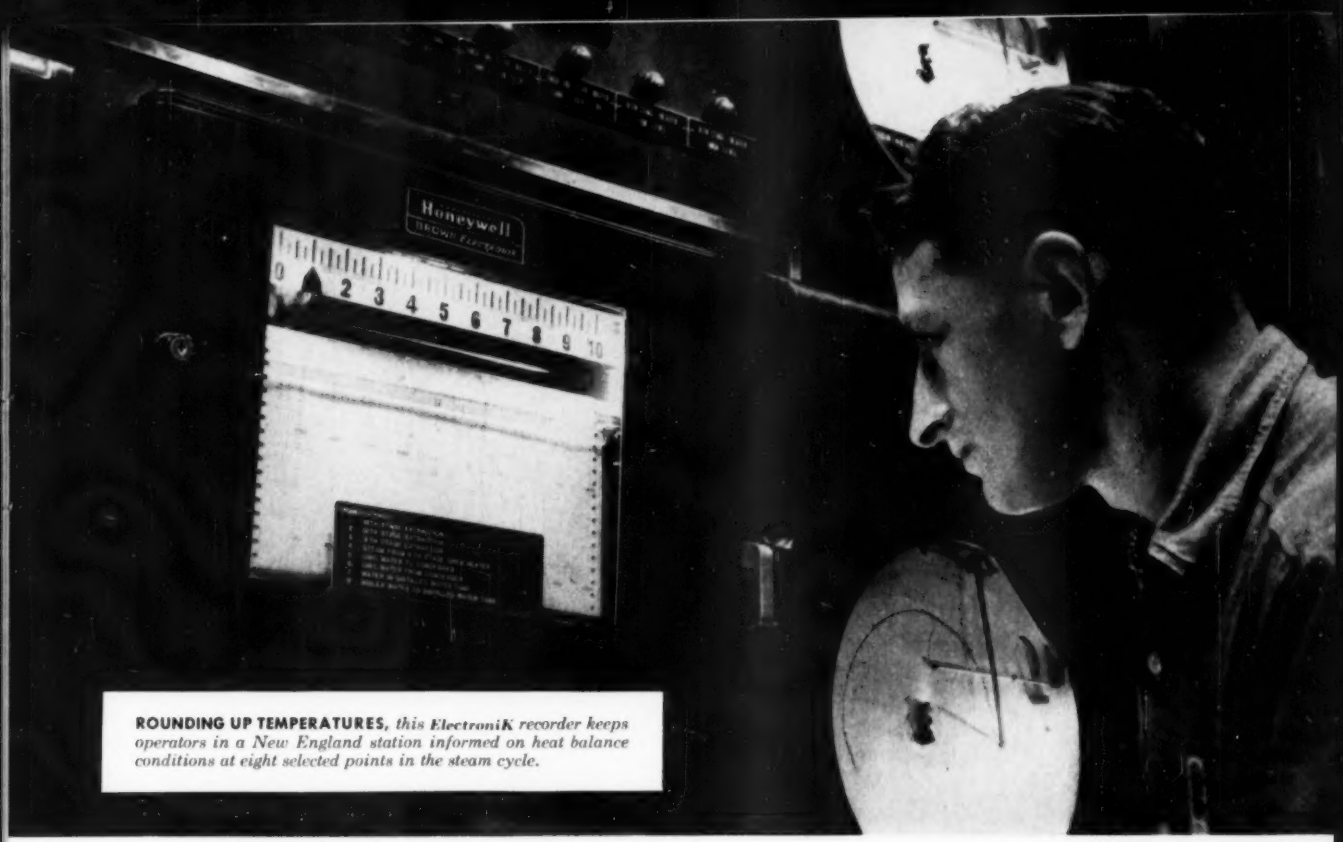
"Building block" approach

These are the building blocks of measurement and control. To combine them into systems custom-fitted to your process, Honeywell offers the know-how gained through years of experience in all branches of industry. Whether your process calls for a single instrument or a complete central control panel, you can be sure of getting the peak in performance and value . . . and the advantages of a single responsibility for the entire installation . . . when you specify *engineered instrumentation by Honeywell.*

Wherever *rely on*



COMPLETE COVERAGE *of industrial requirements for instrumentation is at your command in the Honeywell line. Whatever you need to measure or control . . . to any accuracy . . . with any of a variety of special features . . . you'll find Honeywell instruments offer the most efficient solution.*



ROUNDING UP TEMPERATURES, *this ElectroniK recorder keeps operators in a New England station informed on heat balance conditions at eight selected points in the steam cycle.*

measurement counts...

ElectroniK recorders

FOR ALL the vital measurements that are essential to power plant supervision, you'll get the most in performance with *ElectroniK* recorders. They have every feature that power engineers demand:

They're versatile: the same basic, industry-proved instrument is supplied for measuring temperature, frequency, power, flow, pressure, pH and conductivity. Single and multi-point models are available in a choice of printing speeds and chart speeds . . . readily equipped to operate signals and alarms.

They're accurate: built of life-tested, service-proved components, such as hermetically sealed converters, high-torque balancing motors, and simplified amplifiers. They're unaffected by vibration, atmospheric humidity or dust. They have earned a reputation for staying on the job week after week . . . month after month . . . without interruption.

Behind these instruments stands the largest service organization of its kind, operating from more than 90 offices strategically located in the U. S., Canada, and throughout the world. Ask your local engineering representative for full facts . . . he is as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4587 Wayne Ave., Philadelphia 44, Penna.

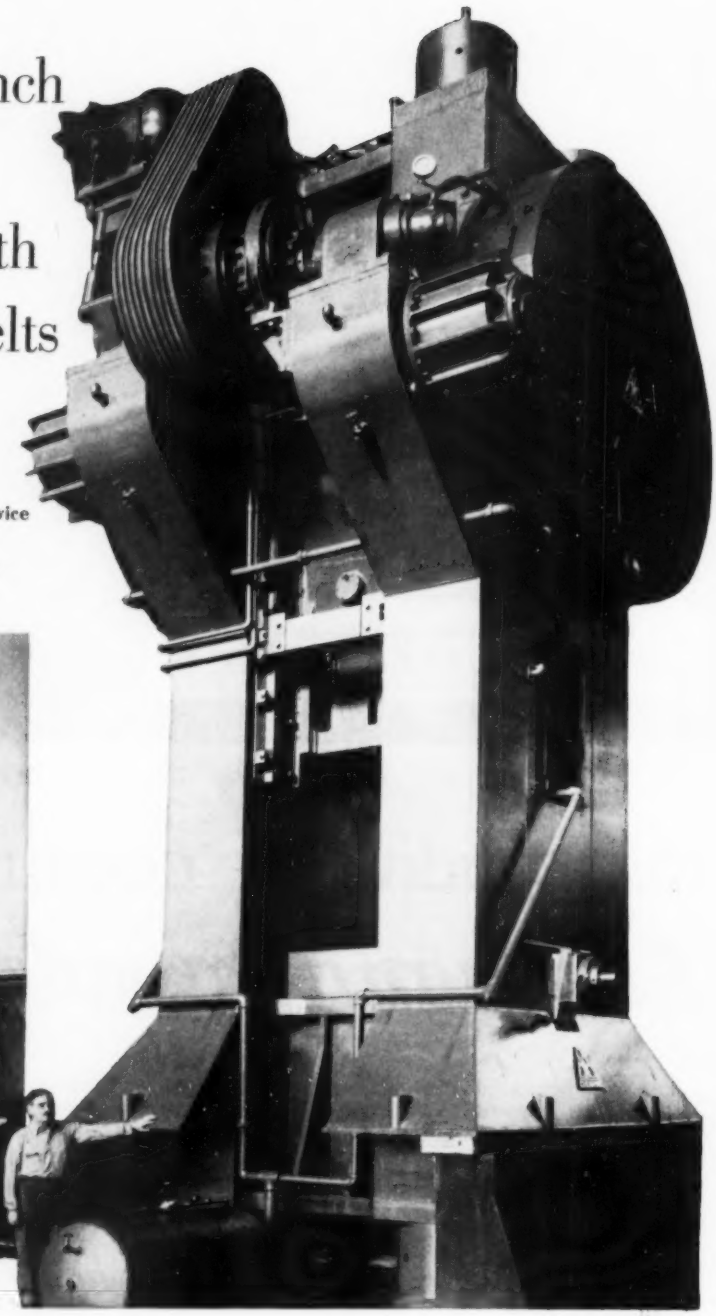
● **REFERENCE DATA:** Write for Catalog 90-2, "Supervisory Instruments for Power Generation."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

For more data circle 514 on Post Card

Controlling the punch of mighty heavyweights...with U.S. Rainbow® V-Belts

A Complete Drive Service
Multiple V-Belts
F. H. P. Belts, Sheaves
Flat Belting and Belting
Special Purpose Belts



Note the U.S. Rainbow V-Belts in multiple drive on these presses. The monster at the right has a capacity of up to 3000 tons.

These powerful presses, used for forming steel, exert tremendous forces. The V-Belts that transmit this power must be capable of handling great shock loads. The belts designed by United States Rubber Company for these presses have the right strength and dependability for the job. Each belt has the unique Equa-Tensil Cord Section that scientifically distributes the load to insure efficient pull with minimum stretch. Protective jackets increase the grip while keeping out dirt and prolonging wear. For large or small drives, you can depend on the quality of U.S. Rainbow V-Belts. Order from your jobber or contact any of the 25 "U.S." District Sales Offices, or write to address below.

U.S. RUBBER
SERVING THROUGH SCIENCE

"U.S." Research perfects it...
"U.S." Production builds it...
U.S. Industry depends on it.

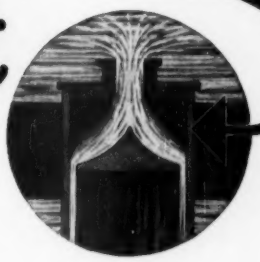
UNITED STATES RUBBER COMPANY
MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

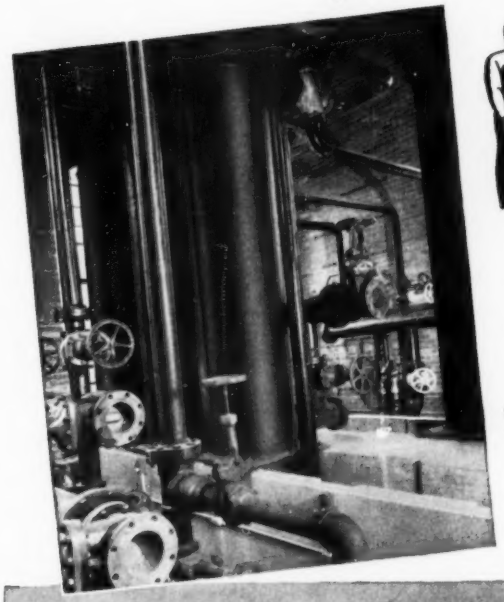
Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

For more data circle 515 on Post Card

Dirty Water can't "Shut-down"...

Vogt

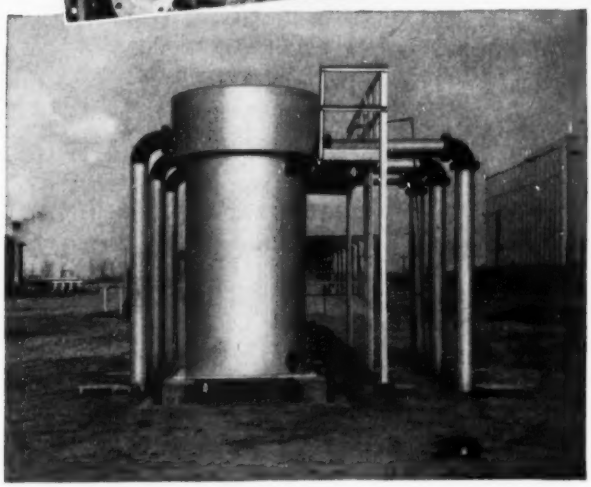




film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

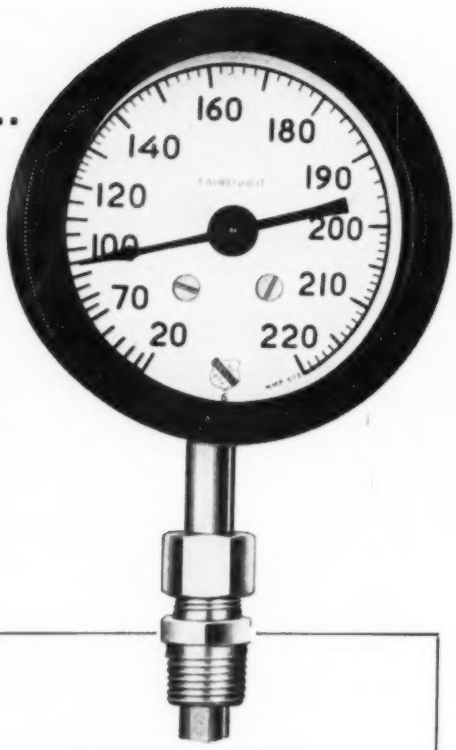
HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

For more data circle 516 on Post Card

Better ANY WAY YOU LOOK AT IT...

AMERICAN "*Every Angle*" DIAL THERMOMETER



The American "Every Angle" Dial Thermometer is easy to install and turn to any position for accurate face-to-face readings. Specify the "Every Angle" — indoor or outdoor design — and this unbeatable feature combination is yours:

DEPENDABLE ACCURACY. The "Every Angle" Thermometer is made of precision-machined, non-corrosive materials and operates by vapor pressure. It is precisely calibrated against certified standards to assure the most critical reading in the upper third of the dial, where the graduations are farthest apart.

CONVENIENCE. Dial face can be rotated 180° and tilted 180° for accurate reading at the most convenient angle.

WEATHER-PROOF DESIGN. *Screw-type ring* with tight-fitting gasket for weather-proof outdoor service; *slip ring* design for indoors.

REINFORCED MOUNTING. Heavy-gauge swivel hinge has a *stainless steel kingpin.* Reinforced connection between hinge and bulb. Greater strength and corrosion resistance, long service life!

EASY INSTALLATION. Socket connections have compression-type bushings. No costly jigs needed — connection easily welded to tanks or other irregular-shaped equipment.

Ask your Distributor to help you select the American "Every Angle" Dial Thermometers with the proper temperature ranges for your needs. Phone or write him today.

SPECIFICATIONS

NON-CORROSIVE DIAL CASE: Non-corrosive aluminum with smooth black finish. No protruding screw heads. Nickel-plated brass cup houses coiled capillary tubing.

DIAL: 3½" diameter. White with black figures. **POINTER:** Black, adjustable. **FRONT:** Heavy plate glass. **MOVEMENT:** Bronze or stainless steel. **BULB AND STEM:** Stainless steel. **SIZE CONNECTION:** ½", N.P.T. **STEM-LENGTHS:** 3", 5-5/16", 12", 18" and 24". **SEPARABLE SOCKETS:** Bronze, carbon steel or stainless steel.

STANDARD RANGES

Fahrenheit	
—60 to 20°	30 to 300°
—20 to 120°	100 to 300°
40 to 140°	90 to 350°
30 to 180°	190 to 390°
20 to 220°	260 to 450°
Centigrade	
0 to 100°	40 to 150°

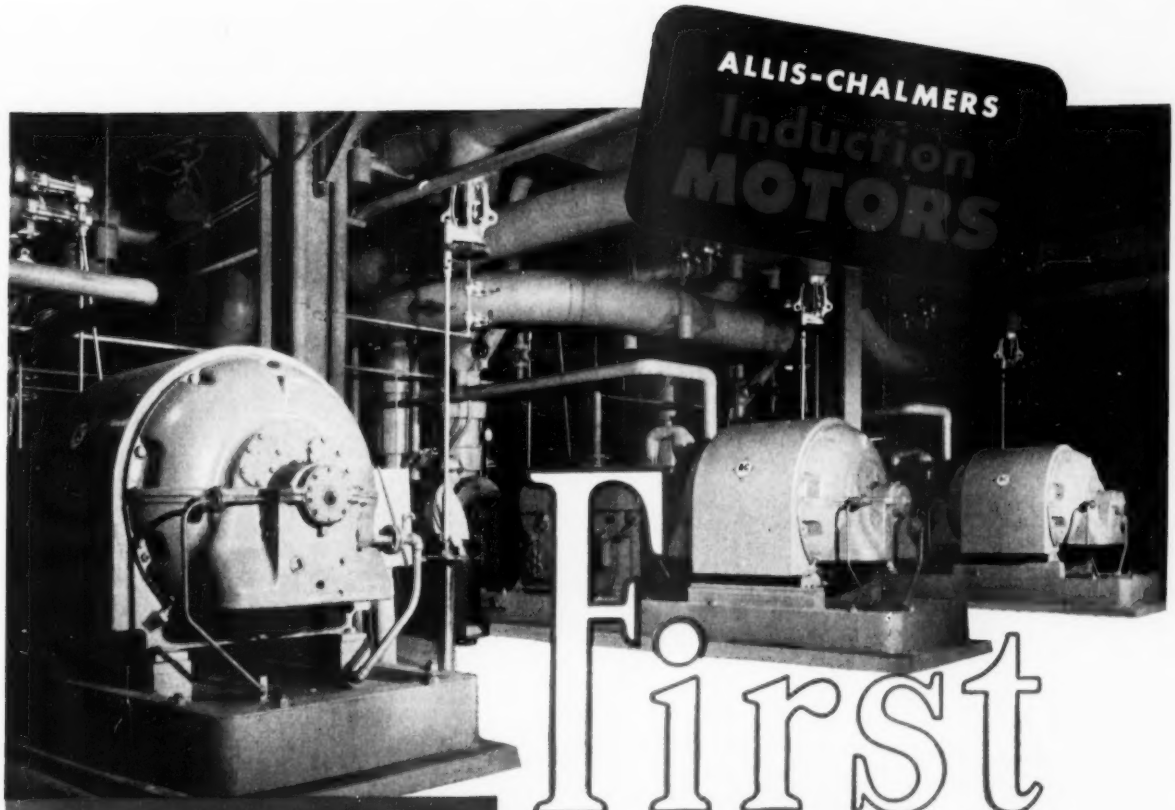
YOUR INDUSTRIAL DISTRIBUTOR makes it his business to see that you get the best possible equipment. That's why he handles only products of proved quality and dependability — like Manning, Maxwell & Moore products.

AMERICAN INDUSTRIAL INSTRUMENTS

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

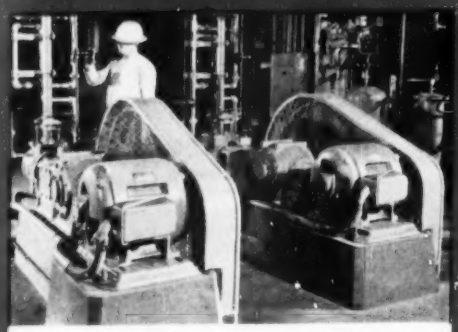
MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'HANCOCK' VALVES, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES. BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

For more data circle 517 on Post Card



First

OF THREE TRIPLETS



Suggested

INDUCTION MOTOR BULLETINS

Drip-proof and splash-proof (End-shield bearing)	½ — 100 hp	51B6210
	15 — 800 hp	51B7693
	60 — 1750 hp	05B7542
Totally-enclosed fan-cooled (End-shield bearing)	½ — 100 hp	51B7225
	40 — 800 hp	51B7149
	125 — 3000 hp	05B7150
Two-pole — 900 hp and larger		05B7550
Large vertical		05B7629
Large pedestal-bearing		05B7771
Totally-enclosed water-cooled		05B7682
Weather-protected, for outdoor use		05R7874

These three 1500-hp, 3580-rpm boiler feed pump motors are the first of three such sets due for installation at Cincinnati Gas & Electric's Walter C. Beckjord station.

Large or small, the auxiliary drive motors for all three generating units at this new station will be Allis-Chalmers designed and built. The fact is, Cincinnati Gas & Electric learned thirty years ago that you can depend on A-C for reliable power plant auxiliary drives.

You can get auxiliary drive motors engineered to fit your requirements by calling in your A-C representative early in the planning stages. For design details, ask for the bulletins listed at the left. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4058

ALLIS-CHALMERS

A-C ALLIS CHALMERS

For more data circle 518 on Post Card

Where *CONTINUOUS FLOW AND*

Zurn LPD Duplex Gate-Type Strainers in common with other types provide continuous flow of liquids. These Strainers can be used for all liquids. Zurn Engineered LPD Strainers are designed to provide the answer to costly shut downs.

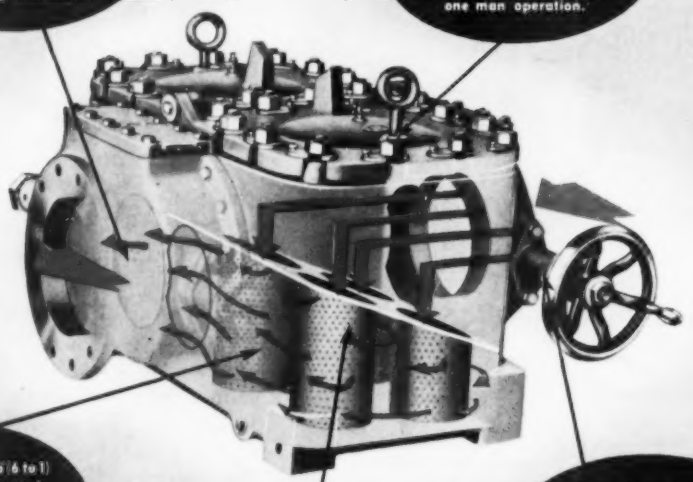
ZURN

DUPLEX GATE-TYPE

L-P-D STRAINERS

Free Floating Valve Disk, easily removed through the valve access cover, insures against binding of valve operating mechanism.

Hinged Cover with "C" Washer Closure and Multiple Basket design facilitates cleaning; permits one man operation.



Zurn LPD Duplex Gate-Type Strainers can be used for all fluids. *They permit high rates of flow with remarkably low pressure drop and immeasurably improve the handling of fluids.*

Large open area ratio (6 to 1) lengthens cleaning cycle relative to conventional style 2½ or 3½ to 1 open area ratio strainers.

Angle Basket design permits straight-through flow, minimizes pressure drop.

Operating Screw cannot be damaged by corrosion or foreign particles in the liquid on the inside or by physical damage on the outside of the strainer.

MAXIMUM CAPACITY are required, use

ZURN DUPLEX GATE-TYPE LOW PRESSURE DROP *STRAINERS*

Design improved for placement of Multiple Catch-Baskets. *This permits straight-through flow which minimizes pressure drop.* Angle Basket design insures complete retention of strained particles when basket is being removed for cleaning. *One man can complete basket cleaning easily, rapidly and at low cost.* Basic face-to-face and centerline-to-base dimensions are favorable for installation in minimum space.

Like all other Zurn LPD Strainers, Duplex Gate-Type Strainers are held at close tolerances for materials, shapes and dimensions assuring the utmost in strength and safety and continuous operation.

Zurn LPD Strainers are widely used to protect close-tolerance control devices and delicate mechanisms, also to protect product purity. They make continuous production processes possible. Zurn Fluid Handling Engineers are available for consultation on your particular problem. Write or wire direct to factory.

J. A. ZURN MFG. CO.

INDUSTRIAL DIVISION • ERIE, PA., U. S. A.

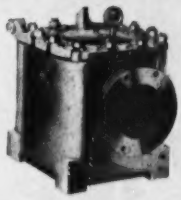
In Canada: **Canadian Zurn Engineering Ltd., Montreal 25, P. Q.**

There is a ZURN LPD Strainer for every fluid handling purpose

Zurn LPD Duplex Strainer, Plug-Type.

Zurn LPD Sinlex Strainer available in offset and straight-through types.

Zurn LPD "Y" Type Strainer available in any cast material and for high pressures.



Zurn LPD Sinlex Strainer, Multiple Basket Type, available in several metals and for high temperature installations.

Zurn LPD Strainer applications include fluid handling lines for lubricating and fuel oil, and oil during the refining process; a wide range of chemicals produced and used by the various process industries; public utility power plants; power stations; industrial plants; ships and high temperature installations. Zurn Fluid Handling Engineers are available for consultation.

Zurn Engineered Low Pressure Drop Strainers are patented and patents pending.

Copyright 1953

WRITE FOR ZURN LPD STRAINER DATA MANUAL NO. 952

This Manual includes *previously unpublished pressure drop data* and gives useful, factual information on fluid handling.

J. A. ZURN MFG. CO.
Industrial Division, Erie, Pa., U. S. A.

Please send me Zurn LPD Strainer Data Manual No. 952.

Name .....

Position .....

Company .....

Street .....

City and State .....

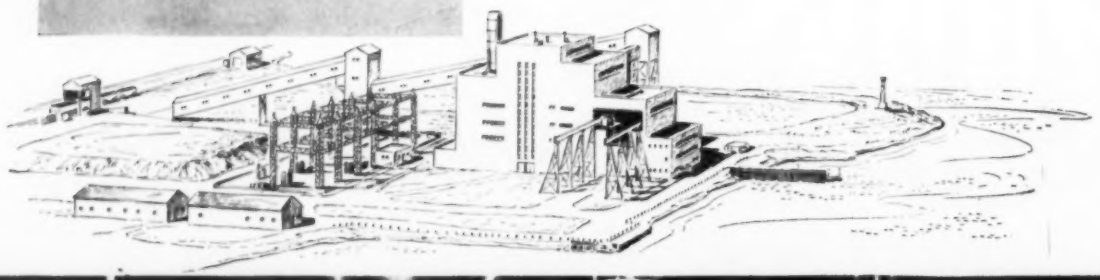
Please attach coupon to your business letterhead.
Dept. PE

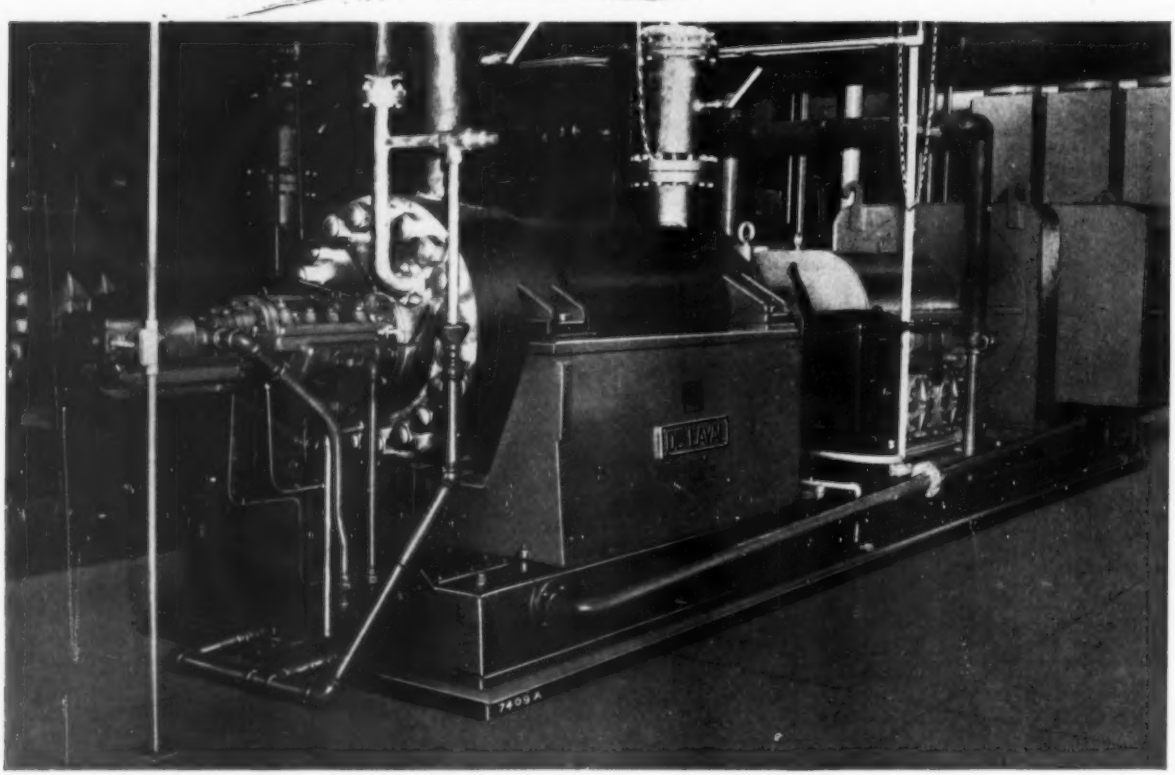
For more data circle 519 on Post Card

DE LAVAL

BARREL TYPE BOILER FEED PUMPS

on the job at Danskammer Point





These two De Laval 11-stage barrel type boiler feed pumps are now helping to produce power for the Danskammer Point Steam Station of the Central Hudson Gas and Electric Corporation. Both pumps, one of which is used for standby service, are sized for full boiler load and will deliver 1,400 gpm of 326F water against 2,155 psig discharge pressure. Two more same size De Laval pumps have already been ordered for the second main unit of the Danskammer Station.

De Laval barrel type boiler feed pumps meet all the requirements of high pressure boiler feed service. They can be thrown on the line quickly without long preliminary warming up. They are not affected by sudden temperature changes. The distinctive De Laval design assures years of reliable service with minimum maintenance.

DE LAVAL *Boiler Feed Pumps*

DE LAVAL STEAM TURBINE COMPANY

816 Nottingham Way, Trenton 2, New Jersey

DL 175

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COCHRANE WATER CONDITIONING
STARTS WHERE NATURE STOPS

AT PENNSYLVANIA ELECTRIC CO.

IT'S A COCHRANE DEMINERALIZER

Cochrane Demineralizer Installation at Pennsylvania Electric Co., Erie, Pa.— Gilbert Associates, Inc., Engineers, Reading, Pa.

• To supply high quality water for boilers operating at 1250 P.S.I.G. the Pennsylvania Electric Company installed a Cochrane Automatic Demineralizer in their Erie, Pa. Power Station. Designed for silica removal, this unit handles 400 GPM in preparing make-up for the boilers.

Demineralization is one of many "water problems" Cochrane's engineers solve every day. Water softening, dealkalization, and deaeration are others—all complex—all requiring expert and specialized knowledge. Whether for process or boiler feed water Cochrane can supply the answer to your particular problem, backed by 90 years' experience in solving industrial water conditioning problems. You'll be sure of unbiased recommendations because Cochrane designs and builds all types of water conditioning equipment.

COCHRANE CORPORATION · WATER ENGINEERS FOR 90 YEARS · 1863 - 1953

cochrane

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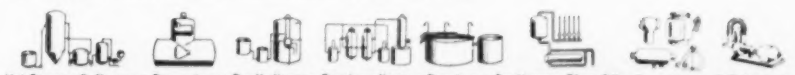
offices in 29 principal cities

In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris



Hot Process Softeners • Deaerators • Dealkalizers • Demineralizers • Reactors • Continuous Blow-Off • Specialties • C-B Systems

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They're Harnessing Cyclones....

with **REPUBLIC** *Automatic* **COMBUSTION CONTROL**

● At a major chemical plant, the first 100% cyclone-fired industrial power plant in the country is being controlled for maximum combustion efficiency by Republic combustion controls. The plant produces 800,000 lbs. of steam per hr. at 1250 psi and 830° F. Steam is supplied to both chemical processes and to a 30,000 kw double-extraction turbine generator.

This cyclone-fired plant serves as *additional proof* that Republic combustion control systems can be adapted for *any* type of fuel firing

There are Republic combustion control systems for all sizes and types of boilers, all arrangements of draft equipment and for all load conditions. There's an experienced engineering staff* to help you get the combustion control system that best fits *your* needs.

For full information, write for Data Book S-21 or contact your nearby Republic field engineer.

**For more than 37 years, Republic has specialized in the design and manufacture of combustion control systems for all sizes of power generating stations.*

FOUR CYCLONES AT HIS FINGER-TIPS . . .

Two 400,000 lbs./hr. boilers fired by four cyclone furnaces are checked and controlled from this central control point. Republic sub-panels on the control bench board are provided for transferring between automatic and manual operation. Also included are Republic biasing sub-panels for adjusting coal-air ratio, primary-secondary air, cyclone ratio and boiler rating.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

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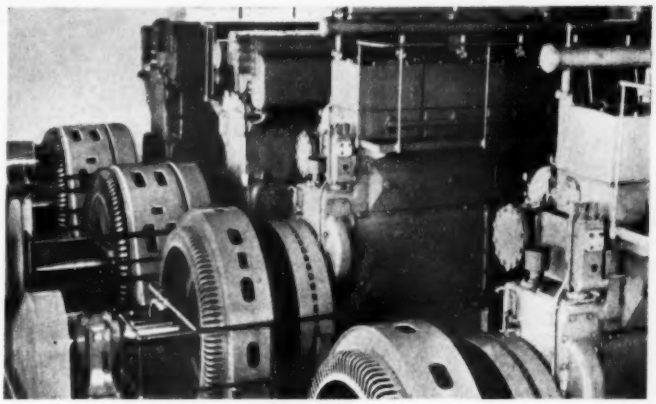
"12,000 H.P. Hours per Gallon with Sinclair RUBILENE"



... says Leo D. Bradley, Manager
Western Michigan Electric Co-operative, Scottville, Michigan

"Our two Cooper Bessemer super-charged 1600 H.P. Model LS8T diesels deliver over 12,000 H.P. Hours per gallon of Sinclair RUBILENE H.D. Oil consumed," says Leo D. Bradley.

"We give much of the credit to the quality of this oil," continues Mr. Bradley. "RUBILENE® keeps our diesels exceptionally clean. Wear is kept at a minimum – the result is high efficiency ... low operating costs ... and low maintenance cost."

Sinclair Products have been used since the generating station first went into operation – 12 years ago. The recommendations made by a Sinclair Lubrication Engineer at that time plus continuous counseling service and superior Sinclair Products have meant substantial savings for this co-operative.

Perhaps a Sinclair Lubrication Engineer can help solve some of your lubrication problems. Phone your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL LUBRICANTS
prolong engine life

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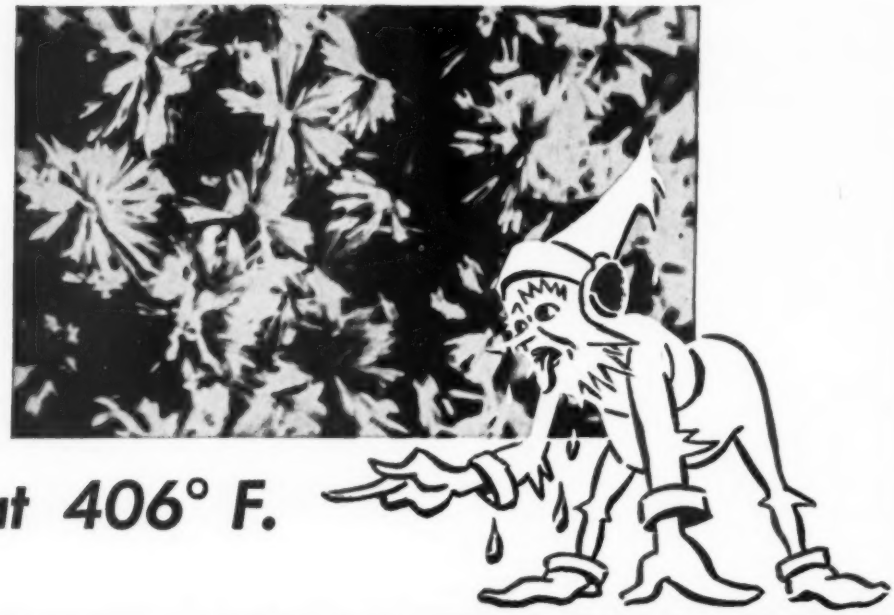
JACK FROST



at 406° F.

MAGNIFIED fifty times, the calcium carbonate scale in the photo above might easily be mistaken for a frosted window pane. It was formed at 250 p.s.i. in one of the Nalco Laboratories' test boilers as a part of the continuing Nalco research program, aimed at keeping such scales *out* of your power plant equipment.

Whether your feedwater and plant conditions produce this type of scale — or any of hundreds of others — your Nalco Representative has the proved solution for eliminating scale or corrosion from raw water inlet to and through condensate return lines . . . permanently . . . economically. Check with him today — or write direct for fast action on your water treatment problems.

DO YOU RECEIVE "*Nalco* ABSTRACTS"?

"Nalco ABSTRACTS" is a quarterly publication containing abstracts of general and technical articles of interest to power plant engineers. If you, like most of us, find too little time to read, "Nalco ABSTRACTS" can be of real help in keeping you up-to-date on current developments. Your copies will be sent free upon request.

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THE *Nalco* SYSTEM...Serving Industry through Practical Applied Science

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Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. Circle item numbers of all catalogs wanted on the postage-free card below, detach and mail

ELECTRICAL

101 Weather Protected Motors — Bulletin GEA-5810 describes weather-protected motors of 250 hp and larger. Explains construction features of the base-ventilated and grade-mounted designs. Ventilation systems are diagrammed, and a table based on hp and desired rpm is included. General Electric Co.

102 Motor Starters — These two new bulletins cover specifications and applications of company's line of manual and magnetic motor starters. Bulletin 404, on manual motor controls, lists special design features of the line, including double-break silver contacts and mounting flexibility. Twelve-pp Bulletin 504 describes design features and uses of magnetic motor starters available in remote control, local control and selector switch control forms. Federal Electric Products Co.

103 A-C Line Regulators — Sixteen-pp Catalog 353 gives information on electronic a-c line regulators, and also presents newly introduced electronic frequency changers. These instruments are designed to convert 60-cycle line to regulated 400-cycle or regulated 50/60 cycle. Catalog provides information on electronic regulator circuitry, uses of regulators, and requirements for special regulators. Sorenson & Co., Inc.

104 Power Packs — Eight-pp Bulletin GEA-5928 presents company's Inductrol Power Packs for a-c lighting and power service up to 112.5 kva, 600 v and below. Explains why voltage should be regulated and the advantages of using packaged equipment to provide this regulation. General Electric Co.

105 Insulation Temperature-Resistance — Technical Publication 21T4, 16 pp, is an article on temperature-resistance characteristics of electrical insulation. Complete with tables and graphs, gives general information on variations in temperature characteristics, composite nature of electrical insulation, and practicability of temperature compensation. Other chapters deal with determining insulation constants for temperature correction factors, dielectric absorption characteristics, and a practical method of obtaining insulation temperature. James G. Biddle Co.

106 Wire Data at Your Fingertips — Now available to qualified power engineers is a pocket-size wiring data and weight computer for solving problems involving power cable, flexible cord, fixture and motor wiring. Information incorporated includes current-carrying capacities, circular-mil areas for a wide range of wire sizes; voltage drop data; conduit size requirements. Also covers weights of bars, single-conductor wires. Please give your job title when requesting this computer. Hatfield Wire & Cable Co.

VALVES, PIPING, ACCESSORIES

107 Valve Selection Guide — Catalog 352A, 44 pp, lists needle, globe, plug, check and relief valves, also gage protectors, and snubbers, bleeders, and special valves. These units are made of various metals, including brass, bronze, steel and aluminum alloy, and are suitable for instrumentation, processing industries, hydraulic systems, industrial and other applications. Details of construction are shown, and complete specifications and dimensions given. Republic Mfg. Co.

108 Remote Control of Valves — Sixteen-pp Bulletin 528 gives valuable information for selecting the correct size flexible shaft for the remote control of any valve, illustrating typical connections. Stresses advantages of flexible shafting and includes installation instructions, full design data. Stow Mfg. Co.

109 For Underground Piping — An insulation specially designed for underground heated piping is the subject of this 8-pp illustrated bulletin. Stresses permanence, economy, extra protection and other features of this lightweight insulating concrete. Illustrates typical conduit arrangements, discusses provision for expansion, re-insulation of existing conduits. Includes heat loss tables. Zonolite Co.

110 Duplex Strainers — Bulletin 200, 8 pp, describes and pictures company's DuoFlo duplex strainers for clearing liquids of objectionable solids and for use on either suction or pressure lines having a continuous flow. Various types of these double-basket strainers are presented, along with information on strainer baskets. Capacity data and pressure drop tables provided. Sheffler-Gross Co.

INSTRUMENTS AND CONTROLS

111 Industrial Controls — Catalog 8305, 84 pp, describes and illustrates non-indicating electric, electronic and pneumatic controllers for temperature, pressure and humidity; also pneumatic and electric valves, switches and relays. Indexed and compiled for easy use, catalog provides specifications, dimension drawings, application data and ordering information. Industrial Div., Minneapolis-Honeywell Regulator Co.

112 Metering and Control Equipment — Sixteen-pp Bulletin 18 is a comprehensive catalog offering information on company's meters, control equipment and engineering services. It is written for engineers in power plants, public utilities and process plants. Fifteen measured variables common to power and process operations form the index for selecting appropriate metering and control equipment. Basic specifications, and detailed literature references included. Bailey Meter Co.

113 Electronic Feedwater Control — Three systems for the electronic regulation of boiler feedwater are explained briefly and diagrammed in Bulletin 52-1073-221. They include a single-element, two-element, and three-element system. Applications for each type are told, and descriptions of the flow measuring, receiving, level measuring elements, power unit and valve are included. The Hays Corp.

JULY 1953
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POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

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Company Name.....

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City.....State.....
(If you prefer delivery at home, give home address, too)

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22	23	24
25	26	27

Helpful Bulletins

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Use this space to ask for tear sheets and other information.

114 Electronic Humidity Control — Instrumentation Data Sheet 10.5-4a describes a new concept of humidity measurement that makes possible direct humidity readings from remote locations. Discusses its application in industrial air conditioning systems. Industrial Div., Minneapolis-Honeywell Regulator Co.

115 Improved Tachometer — Bulletin 751 announces a new five-range hand tachometer with improved slip coupling overspeed device. Explains operating principle, advantages. Illustrated with photos, gives data on range combinations. Herman H. Sticht Co., Inc.

116 Adequate Protection? — This illustrated 12-pp booklet tells how to determine whether current actuated protective devices are really protecting. Explains importance of such current actuated protective devices as overload relays and circuit breakers, and gives step-by-step instructions for testing and calibrating them. Multi-Amp Corp.

117 Recording Potentiometers — Three new specification sheets describe and illustrate Brown Electronic recording potentiometers. Specification Sheet 160 covers circular chart recorders; Specification Sheets 164 and 165 cover single and multiple record strip chart recorders. Construction and engineering details included. Industrial Div., Minneapolis-Honeywell Regulator Co.

PUMPS, COMPRESSORS

118 Centrifugal Pumps — Bulletin WQ-214 introduces manufacturer's new Type DF, an end-suction, centrifugal pump in capacities to 1000 gpm, heads to 400 ft. It is adapted to pumping water, condensate, solvents, brines, caustics, organic liquids, hydrocarbons, gasoline, oils. Bulletin illustrates design features; includes dimensions, specifications. Warren Steam Pump Co., Inc.

119 Screw Pumps — Bulletin SE-5, 6 pp, presents external gear and bearing, bracket-type screw pumps for pumping non-lubricating fluids, semi-fluids. Explains applications and advantages of the pumps and provides large sectional illustration showing construction features. Sier-Bath Gear and Pump Co., Inc.

120 Compressors, Pumps — Catalog 546, 6 pp, presents company's line of air and gas compressors, Oilfreair and Oilfregas compressors, dry vacuum pumps, aftercoolers, Airchek valves, and centrifugal pumps for boiler feeding and general applications. Includes brief descriptive data along with illustrations, also sizes. Pennsylvania Pump and Compressor Co.

121 Ceramic Plungers — Bulletin W-404-B5 lists chemical and physical properties of the plungers and describes the process by which they are manufactured. Discusses corrosion- and abrasion-resistance and high strength properties of these plungers for reciprocating pumps. Gives installation tips. Worthington Corp.

The Reader Service Card below needs no postage. Just circle item numbers of all bulletins wanted, fill in name, company, detach and mail

BOILERS AND AUXILIARIES

122 Automatic Boilers — In addition to providing detailed engineering data and specifications, Form 102 also discusses the features and advantages of manufacturer's automatic boilers, ranging in size from 10 to 500 hp. Pictures installations. Boiler Engineering & Supply Co.

123 Boiler Baffles — Here's a new bulletin on the application of streamlined baffles to boilers of all types and sizes. Includes 21 drawings of boilers showing how these baffles are installed in each specific unit to secure cross flow of gases of combustion and tapered gas passes with resultant increase in steam output. The Engineer Co.

124 Modern Burners — This bulletin covers gas and dual-fuel firing for heating, processing and power. Emphasizes advantages of zone fire control for low start and modulated firing permitted by company's vertical gas burner, also features of the "inshot" type burner with its radiant heat. Also describes a new dual-fuel package unit, and ring-type burners for intermediate and high-pressure gas. Iron Fireman Mfg. Co.

HEATING AND VENTILATING

125 Industrial Heaters — Catalog 1510, 32 pp, presents company's standard and heavy-duty centrifugal fan industrial heaters for use in manufacturing bays, warehouses and other large areas where conventional heating equipment is inadequate. Information on where to use the heaters, at what circulating capacities and temperatures, and how to place them is given. Automatic temperature control is explained, and how to estimate heat loads is told. Typical specifications and examples and performance data included. Sturtevant Div., Westinghouse Electric Corp.

126 Suspended Space Heaters — Bulletin 543, 6 pp, shows a new line of suspended space heaters for use with any type of gas fuel. Provides specification data with dimensions and capacities of both propeller fan and blower type units with output capacities ranging from 70,000 to 178,000 Btu per hour. Tells applications for heating, ventilating and process drying, with or without ductwork. Dravo Corp.

127 Balanced Industrial Ventilation — The scope of Bulletin 115 is limited to problems resulting from the relationship of exhaust and make-up air systems, and its bearing on the heating load. Discusses problem created by exhaust system and presents a solution. National Association of Fan Manufacturers, Inc.

128 Duct Insulation — This new 16-pp design data booklet on Fiberglas duct insulations contains more than 40 photos and drawings of rigid and flexible insulations for the exterior and interior of warm and cold air ducts. Includes information about a new flexible duct liner which may be installed on metal sheets before they are bent to form ducts. It is sprayed with a coating of Neoprene to prevent erosion and reduce frictional loss. Owens-Corning Fiberglas Corp.

TOOLS AND WELDING

129 Metal-Cutting Guides — Bulletin 101 describes and pictures guides for hand-held cutting torches. Tells how these

(*Continued on page 118*)

BUSINESS REPLY CARD
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POWER ENGINEERING
110 South Dearborn
CHICAGO 3, ILLINOIS

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*Could you make this report about your diesel engine?**

CITY OF BESSEMER, MICHIGAN REPORTS:

Nordberg Diesel engine used by Bessemer, Michigan Municipal Power Plant.

PISTONS PULLED AT 24,600 HOURS!

- All rings were free
- No carbon in ring grooves
- All original rings replaced in original grooves
- Rings should last at least 10,000 more hours
- Maximum cylinder wear was .004 at top, .002 at bottom

OIL CHANGE AT 5000 HOURS!

- No oil added to crankcase between changes
- Power cylinders fed at rate of 5 drops per minute
- Main bearing, rod bearings show very little wear
- Average K.W. per gallon of fuel is 13.5 @ 60% load factor

EXCELLENT

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Superintendent,
Bessemer Light Utility.

Note:

FOR TOP ENGINE EFFICIENCY, BESSEMER RELIES ON:

Cities Service DC-930 Oil used for crankcase lubrication!

Cities Service DC-230 Oil used for power cylinder lubrication!

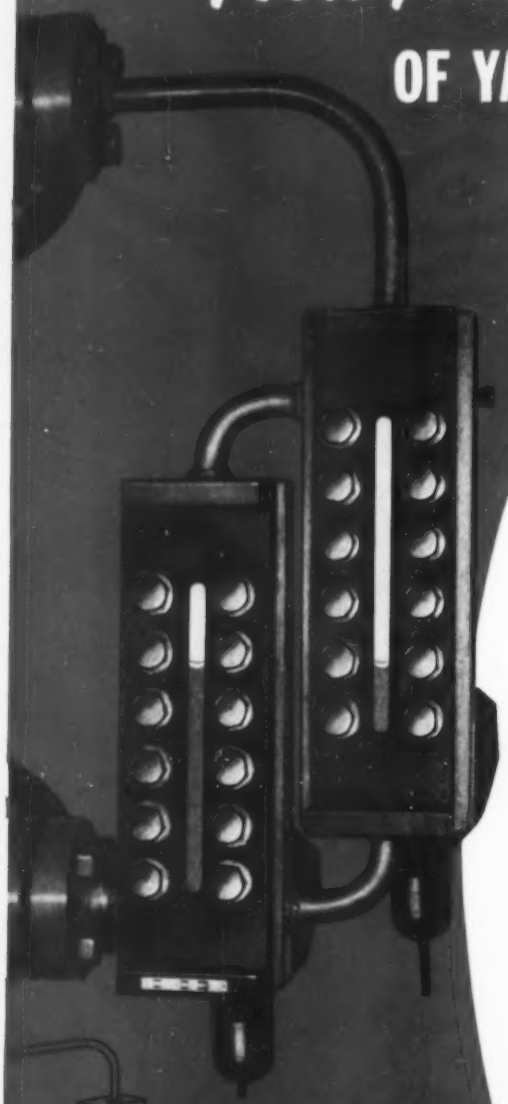
* Why not contact your nearest Cities Service Representative or write Cities Service Oil Company, Dept. G17, Sixty Wall Tower, New York City 5, New York.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

For more data circle 525 on Post Card

Now Available... TELEVISION OF YARWAY FLAT GLASS GAGES WITH RCA INDUSTRIAL TV



RCA Industrial Television is now available for televising at a distance, boiler water level readings as indicated on Yarway Flat Glass Water Gages.

Yarway's broad experience in boiler water level indication, and RCA's leadership in the field of television, have been combined to give modern power plants "live" readings at any location in the plant.

This optional TV feature extends the already wide application of Yarway Gages in the steam power field. It is another of recent Yarway developments aimed at more accurate, more dependable, less costly water gage service.

Such features as the new *separated design with interconnecting expansion loops*, *Type "M" Illuminator* that causes the meniscus to shine like a star, the use of *tie-bar-type water columns*, *Yarway Welbond gage valves*, and *Yarway Pressure-sealed "floating assembly" gage glass inserts* make Yarway gages the modern gages for modern plants.

Your Yarway engineer will be glad to tell you about the new television feature, as well as the other Yarway advantages, or if you'd rather first have a descriptive bulletin, ask for Bulletin WG-1811-TV.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

● Yarway Flat Glass Gage of the new "separated design" is televised by compact, lightweight RCA Industrial Television Camera shock-mounted on a special base, on which illuminators may be installed. The RCA monitor unit can be installed on the operating room panel or at any other desired location.

For more data circle 526 on Post Card

RCA Industrial TV

PRECISION INSTRUMENTATION FOR THE POWER FIELD

For precise reproduction of remote readings—for easy viewing of operations that are now too difficult to watch—RCA introduces sharp-focus, high-definition industrial television.

The RCA Vidicon camera tube packs a maximum of image resolution into its lightweight, heavy-duty TV chain. The Vidicon tube—only 6" long by 1" in diameter—operates on the same scanning principal as commercial television—provides a clear, crisp picture that you can trust for accuracy.

FITS ANYWHERE—OPERATES ANYWHERE

Because of its small size—because there are only two units in a complete RCA Industrial TV chain—RCA Industrial TV can be used practically anywhere.

Typical power applications for RCA Industrial Television include: remote viewing of water level gages and meters; observation of internal furnace conditions; and smoke control.

- The following field-tested accessories—

Furnace water-cooled lenses	Outdoor weather-proofed housings
Automatic iris control	Remote panning
Shock-proof mounts	Industrial auxiliary viewers

—make RCA Industrial TV practicable indoors or outdoors in high or low ambient temperatures.

FOR INFORMATION write RCA Engineering Products Dept., Camden, New Jersey.

● RCA Industrial TV monitor can be panel-mounted. Single cable connects monitor to camera. Power supply—110 volts, 60-cycle AC.

● RCA Industrial TV Camera weighs only 7½ pounds, measures 3" x 5" x 10". Once camera is set in place, all adjustments can be made from face of monitor.

Industrial Products

RADIO CORPORATION of AMERICA

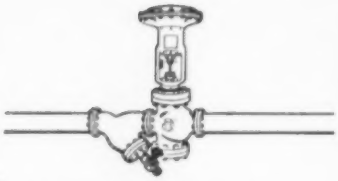
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N.J.

In Canada: RCA VICTOR Company Limited, Montreal

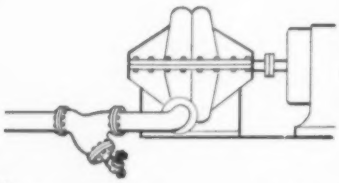
For more data circle 527 on Post Card

Which of over 150 Leslie strainers is the one for YOUR job?

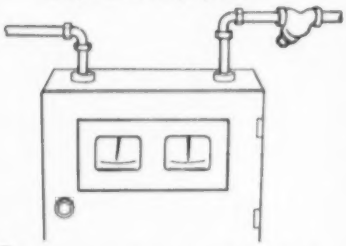
THREE "MUSTS" FOR GOOD PIPING PRACTICE . . .



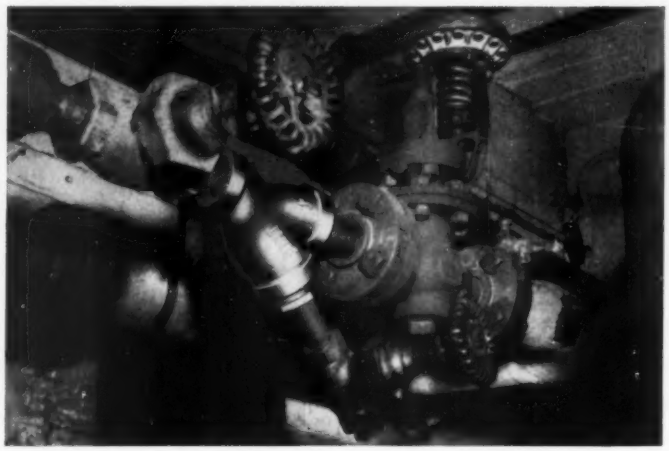
1. **For protection of control valves.**



2. **Protection of pumps, turbines and process equipment.**



3. **For superfine cleaning of air, steam and liquid flows, Leslie "Poromet" filters trap particles down to .001".**



WHICH WILL GIVE COMPLETE PROTECTION AT LOWEST COST?

Just considering strainer body material and screen specifications alone, there are over 150 *standard* combinations of "Y" type Leslie strainers. Each is engineered to do specific jobs under specific conditions . . . there's a "Leslie" for any industrial or marine pipeline strainer application.*

Then, with the myriad of pipe sizes and end connections, it's apparent that picking the right strainer to protect valuable equipment exposed to flow is *not* a "pin-the-tail-on-the-donkey" task.

*There are standard units for pressures to 2500 psi; temperatures to 1050° F; semi-steel, cast bronze, cast steel and cast alloy steel; screwed, flanged, welding or ring-type ends; sizes from ⅛" to 1".

RESERVE YOUR FREE COPY OF 12 PAGE BULLETIN 5308

soon to be released, showing strainer dimensions, pressure drop charts and pressure-temperature limit tables. Reserve your copy today. Write LESLIE CO., 301 Grant Ave., Lyndhurst, N. J.

It costs no more...

to get the right equipment for the right job. In fact, it costs less. It will pay to call your Leslie Engineer before specifying strainers . . . or any pressure, temperature or level control equipment. He's listed in the classified telephone directory in principal cities—under "Valves" or "Regulators."

PRINTED IN U. S. A. 2439

TRADE LESLIE MARK

THE FIRST NAME IN PRESSURE, TEMPERATURE AND LEVEL CONTROLS
Since 1900

LESLIE CO., 301 Grant Avenue, Lyndhurst, New Jersey

For more data circle 528 on Post Card

14 TONS AT A TIME

70 tons of coal stockpiled in 5 passes by Allis-Chalmers HD-20 Tractor with Special Coal Blade

COAL is brought to the power plant of a large northern Indiana industrial plant by rail. Cars are dumped over hoppers and coal not needed immediately at the plant is stockpiled.

As this coal flows from the stacker it is dozed out over the stockpile by an Allis-Chalmers HD-20 Tractor equipped with specially designed Baker coal blade. The coal from 70-ton cars is moved 150 to 200 ft. in five passes, coal from two 50-ton cars takes seven passes — an average of 14 tons at a pass.

Tractor Compacts Coal

The coal is well compacted to help prevent spontaneous combustion, through the repeated trips of the heavy tractor over the stockpile. Complete with blade, the unit weighs approximately 25 tons — enough to tightly pack the horizontal layers of coal and eliminate the flues that often lead to burning.

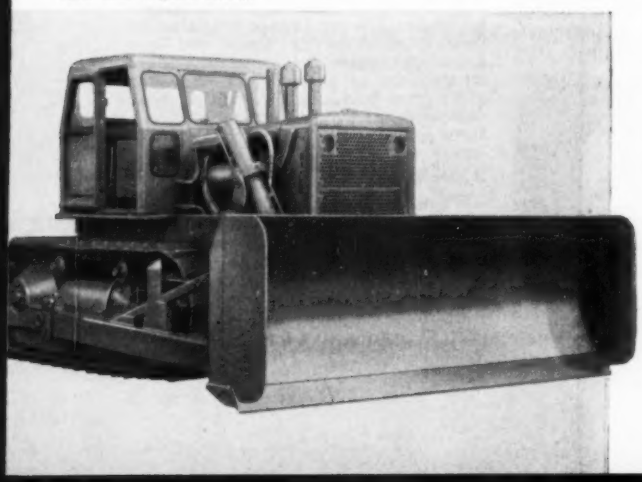
With a 175-hp. diesel engine, the tractor has plenty of power for moving big loads. A hydraulic torque converter drive multiplies torque up to four and a half times where needed to start the load of coal, then automatically accelerates to the highest traveling speed that conditions permit.

Has Hydraulic Steering

Convenience of operating and servicing the HD-20 Tractor also contributes to its high over-all output. Hydraulic control permits steering with the touch of a finger. Other operator conveniences include comfortable seats, clean platform and excellent visibility. For simplified repair, major tractor assemblies are easily removed without disturbing adjacent parts. Truck wheels, idlers and support rollers need be lubricated but once in 1,000 hr. There are no lubrication fittings under tractor.

Additional information about this HD-20 Tractor and coal blade — or about the three other Allis-Chalmers tractors, tractor shovels, scrapers and motor scrapers for stockpiling coal — can be obtained from an Allis-Chalmers dealer or direct from the company.

Big Allis-Chalmers HD-20 Tractor has 175-hp. diesel, weighs 25 tons complete with blade. Baker coal blade has extra, 56-in. height and 14-ft. length, plus boxed-in ends that help carry 15 to 20 percent larger load than regular blade.



ALLIS-CHALMERS
TRACTOR DIVISION · MILWAUKEE 1, U. S. A.

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 35 and 113 for your request. Just circle the numbers of the items you'd like to know more about

1—ELECTRONIC "PACKAGES"

For controlling and recording; designed for quick, accurate response

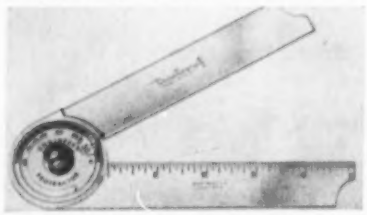
These two new "packages" are built around basic components of company's all-electronic Autronic system. A recording package is composed of the Type P2T pressure primary element transmitter, the Type A2R recorder and a constant voltage transformer. A controlling and recording package includes these items as well as a Type A3C controller with proportional band and automatic reset, manual control and power relay. Continuously adjustable ranges and spans of the equipment are: 0–40 to 0–200 psi; 0–200 to 0–1000 psi; and 0–1000 to 0–5000 psi. Ranges are adjustable to a 50 percent zero suppression of the actual span setting.

In addition to instantaneous response, manufacturer says these systems offer unrestricted location of the various units, adaptability to many process requirements and interchangeability of components without recalibration. Initial cost is said to be low and maintenance simple. The Swartwout Co.

2—ADJUSTABLE PROTRACTOR

Made of clear plastic; costs little and does a lot of drafting jobs

The Tractograf is called a miniature drafting machine in itself. According to manufacturer, any number of angles, from zero to 180 deg, can be drawn instantly without turning, sliding or moving the protractor out of position. You simply swing the upper rule arm to the



desired angle and lock the adjustment knob. A magnifier, built-in over the registration mark, gives clear, hairline adjustment. Also contributing to easy reading is the white dial, and the 180-deg arc calibrated in sharply defined 1- and 5-deg divisions.

Frequently-needed mathematical formulae are printed on the reverse side of the dial, and there's a handy 5-in. rule on the lower arm. The Tractograf is 2-in. wide, 7-in. long when set at zero. Its price is listed at less than $2.00. Way-Mac Mfg. Co.

3—HUMIDITY CONTROL

For air conditioning system, is designed for accuracy, dependability

This instrument offers a means of controlling moisture content or relative humidity in air conditioning without the need for a moisture sensitive element to determine humidity, it is explained. The instrument is applied to company's method of air conditioning in which air is dehumidified by a liquid absorbent.

As the air conditioner removes moisture from the air stream passing through it, the absorbent liquid becomes diluted, and is continuously reconcentrated to the boiling point of the mixture of absorbent liquid and water. Based on this principle, the new instrument consists of a tube with a heating element. A sample of the reconcentrated liquid on its return flow to the air conditioner continuously enters this tube and is heated to boiling point. A thermostat with its sensing element in the tube is set at the boiling point desired. The thermostat operates the concentrator unit to furnish a greater or less concentration of the absorbent, as called for by the thermostat setting. Niagara Blower Co.

4—"JET" PUMP

For handling the condensate drainage in steam process plants

According to manufacturer, the ability of this jet unit to handle condensate, gases and entrained air at high speed, temperature and pressure in a closed circuit affords higher latent heat transfer to the product and substantial savings of Btu's. Substantial increases in quantity, better quality control with less time and waste are reported in many industries, as well as fuel savings of 15 per cent. Publication 3250 gives details on the jet pump. Cochrane Corp.

5—FLAW FINDING KIT

Is portable unit for on-the-spot inspection for metal soundness

Although it holds enough materials for many inspections, the new all-metal Dy-Chek Flaw Location Kit can be carried in one hand. Its contents include a pint of dye penetrant and two of dye remover, two developer pressure spray containers, a pint of developer (for use where compressed air is available), three brushes, magnifying glass, shaker of hand soap and instructions for use.

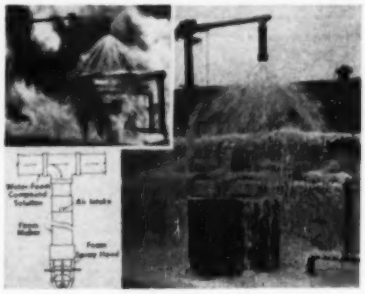
Dy-Chek materials are used in the field much the same as in the plant. The procedure includes pre-cleaning of the part or area with the dye remover, applying the liquid penetrant, removing the excess with dye remover and rinsing with water (where water is available), and spraying on the developer. The

developer dries quickly pulling the hidden red penetrant to the surface at locations where flaws exist. Cracks appear as red lines and porosity is indicated by red dots. Depth of defects is indicated by richness and speed of bleed-back. Turco Products, Inc.

6—SPRAY-TYPE FOAM MAKER

For protection of medium-sized petroleum and chemical hazards

Designed to generate the foam right at the hazard, this foam maker has a cone-shaped spray head which discharges in an even pattern. It is intended for use in fixed systems, singly or in multiples, indoors or out, with the spray unit located at least 4 ft above the hazard to obtain full discharge coverage. How the blanketing foam acts to put out a transformer insulating oil fire is shown in the photos. The foam maker is also suggested for protecting pump rooms, load-



ing docks, drain boards and sumps.

The foam maker and spray unit is about 15-in. long, 2½-in. wide. A mixture of water and foam compound is supplied to the foam maker under pressure. The foam is formed mechanically, expanding many times its original volume, and is carried to the spray unit for discharge. Company points out that these devices are approved for use with water discharge alone, and that water will not adversely affect the foam already deposited. Two capacities are available: one has water rates of 22 gpm at 30 psi and 40 gpm at 100 psi; the other, 33 gpm at 30 psi and 60 gpm at 100 psi. Pyrene Mfg. Co.

7—GAGE PROTECTOR

And pressure gage snubber, serve to prevent ruin of pressure gages

Two new devices designed to protect pressure gages include a gage protector which automatically shuts off the pressure line when it exceeds the capacity of the gage, and a self-cleaning pressure gage snubber. The protector units are available for standard gages from 15 to 5000 psi. When line pressure drops below cutout pressure the valve opens automatically. The snubber is available for three types of service: heavy and light fluids and gases. It dampens pressure fluctuations so there is no damaging effect from fluid hammer, chatter check valves or pump pulsations, manufacturer explains. Republic Mfg. Co.

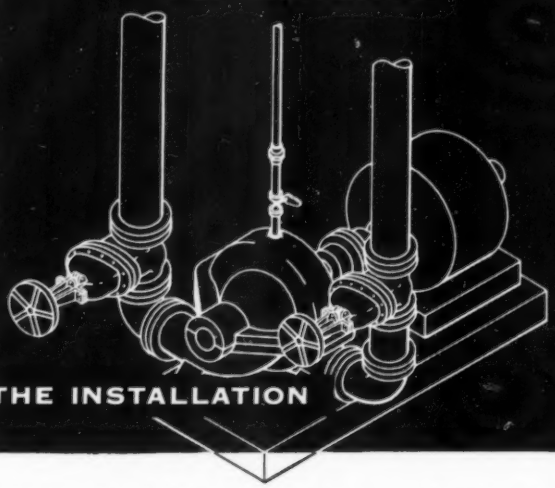
8—ORIFICE METER

Offers continuous boiler blow-off without excessive heat waste

The new Orifice Meter is designed to continuously remove a high percentage of the foreign solids present in all waters and tending to accumulate in boilers due to the evaporative process. The meter is said to maintain this accumulation ef-

Will Your Valves Last 50 Years?

...on this Tough Pump Service, for instance



THE INSTALLATION

VALVE SERVICE RATINGS

SUITABILITY:
Doing the job for 50 years

MAINTENANCE COST:
Routine care only

SERVICE LIFE:
Installed 1903—Now on new pumps

OPERATING RESULTS:
No shutdowns for valve trouble

AVAILABILITY:
Catalog item—Current No. 465½

At The Great Western Sugar Company, Longmont, Colorado, plant, with Crane Iron Body Wedge Gate Valves on suction and discharge lines of juice pumps.

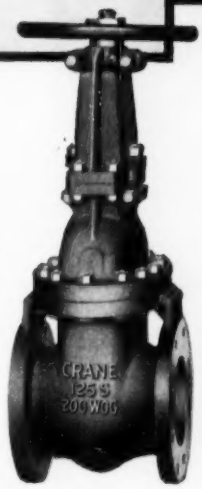
THE CASE HISTORY

Originally the Crane valves were installed on belt-driven pumps when the plant was built in 1903. In 1952, the old pumps were replaced. Nearly all the Crane valves were found in good condition and put right back in service on the new pumps.

It's no easy job these Crane 6 and 8-inch, 125-pound brass-trimmed gate valves have been doing since 1903. The plant operates on 80-day continuous beet sugar campaigns. In spite of intermittent operation, and with periodic routine maintenance only, the Crane valves never fail to operate freely, smoothly, and seat tightly. For 50 years they have assured dependable, positive flow control in event of pump failure—and they're still doing it.

THE VALVE

Here is today's model of these "50-year service record" Crane 125-pound iron wedge gates. Still made to the most rigid quality standards, these modern valves keep building unusual performance records in every industry. They come in patterns for every need. See your Crane Catalog or your Crane Representative.



THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois

Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 530 on Post Card

ficiently, yet economically, at a safe level below the critical point at which wet steam and priming develop.

According to manufacturer, the Orifice Meter is designed to provide just the right rate of flow required for every type of boiler regardless of water condition or evaporative capacity. Connected at the surface, the flow control unit continuously drains the proper amount of water from the area of greatest concentration of impurities. It is credited with affording worthwhile savings by eliminating unnecessary waste of fuel and water.

Heart of the system is the orifice plate with its 17 calibrated orifices. These openings are graduated in size to permit selection of the proper orifice for the operating condition likely to be encountered. The desired orifice can be readily brought into the line of flow, making it possible to change or regulate the flow as required. Company says this meter is engineered to combat the excessive wear commonly associated with Boiler blow-off service. Madden Corp.

9—LEVEL INDICATORS

Are easier to read because of new type face and cover plate

In the new Yarway Remote Liquid Level Indicators the raised, transparent face permits the indicator arm to be extended under the cover to a position where it can be viewed from the side as well as from the front. This improved visibility makes it possible to check boiler water levels or other liquid levels from almost any location in the control room or wherever the indicator may be installed. The indicating mechanism is operated by the boiler water itself. These indicators are of the manometric type, with automatic temperature compensation. Yarnall-Waring Co.

You may use the post cards on pages 35 and 113 to ask for further information on any of these new products

11—CONDENSATE PUMP

Is designed to offer high capacity at low cost; requires no pit

Even though the return pipes are as low as 1 ft above the floor, this condensate pump does not require a pit, says its manufacturer, and it handles 8000 sq ft of radiation at 20 psi. It contains an all bronze centrifugal pump and flexible couplings which isolate the pump from the motor and piping to prevent pipe cramp, misalignment, wear and noise. Power is supplied by a ¼ hp 115 v, single phase motor mounted on a drip-lip, heavy structural steel base with a ½ ips drain. The unit is said to have a large capacity safety factor providing for a 1 to 3 "on-off" operating cycle with tight traps; and to be built for long service. Walter H. Eagan Co., Inc.

12—PROCESS CONTROL

Is designed to eliminate distance factors and reduce time lag

The American Electronic Process Control System is described as a complete electronic system utilizing advantages of electric and electronic transmission of measurement and operational signals. Manufacturer says the system is a highly efficient means of measuring and controlling temperature, pressure, differential pressure, liquid level and flow; also that there is virtually no lag in the transmission signal. Because of the dependability and accuracy of the simple d-c signal, controllers can be installed in the control room regardless of the distance from the process area, it is stated, and stability is so high that narrower proportional bands can be used. Control components are standardized for interchangeability at the panel. Manning, Maxwell & Moore, Inc.

13—IMPROVED ELECTRICAL TAPE

Plastic with pressure sensitive compound, of high dielectric strength

A new member of this company's Bull Dog line of tapes, this new plastic product is claimed to resist weather, corrosive chemicals, water, oils and abrasion. It is thin and said to have good

adhesive qualities and conform to irregular surfaces. Its dielectric strength is announced as averaging over 1000 v per mil of thickness. The tape comes in 60- and 20-ft rolls in ¾-in. widths, and in a 12½-ft roll in ½-in. width. Manufacturer predicts that this product will replace many conventional types of friction tape and splicing compounds now being used for insulation on wires. Boston Woven Hose & Rubber Co.

14—MINIATURE INDICATOR

Features built-in alarm devices, convenience of installation

The new Ratographic Miniature Indicator, for mounting in either graphic or conventional panels, has a total scale length of 5¾ in., calibrated from 0 to 100. The scale, mounted on a rotating drum, is positioned by a pneumatic sig-

nal from any remotely-located primary or secondary instrument.

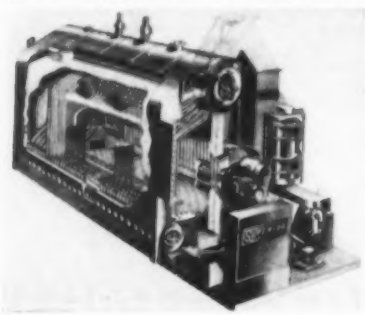
A feature of the indicator is the variety of alarms and operating guides that can be incorporated. Combinations of visual and audible alarms are available to keep a continuous check on the measured variable and warn the operator when it is outside required operating limits.

The indicator is pneumatically operated, with full scale travel obtained between 3 and 15 psi on standard models. The compact indicator is 5⅜ in. high, 2⅜ in. wide and 7¾ in. deep. It can be removed from the panel simply by pulling it from its case, since electrical and pneumatic connections are plug-in type. Fischer & Porter Co.

10—WATER TUBE STEAM GENERATORS

Ready to install; embody advance features of packaged construction

These new water-tube steam generators are built for automatic firing with oil, gas or stoker coal. They are available in nine sizes with capacities ranging from 5300 to 33,000 lb of steam per hour and for pressures to 400 psi. Incorporating the "A" type of construction for quick steaming, the tube layout utilized is designed to protect the steam drum from direct impingement. The large steam drum provides ample steam releasing surface, and internal steam separator is provided to assure dry steam delivery. Water wall tubes are fed uniformly through the adequate lower drums, which are of uniform diameter throughout their entire length. Ample hydrostatic head assures rapid circulation and immediate response to fluctuating load demands, it is noted.



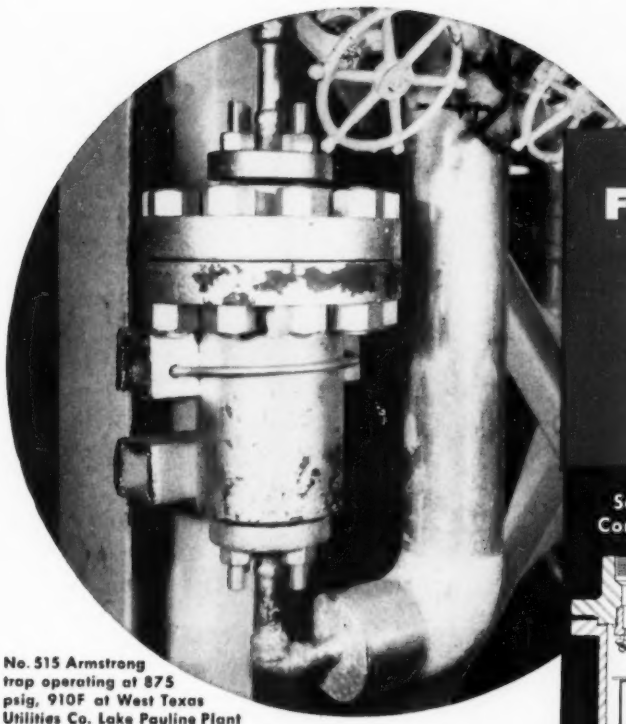
A multiple fan induced draft system is incorporated for cleaner, quieter operation and to insure purging of the combustion chamber before and after firing. Dual induced draft fans and divided second pass afford flexibility of firing range. Shutting down either fan acts to permit operation at lower firing rates than generally considered practical.

The new generators are shipped ready for operation. Built on a structural steel base, they require no special foundation. Refractory, insulation, burner, controls, inter-connecting piping and wiring are installed at the factory. Units can be furnished for permanent outdoor use. Superior Combustion Industries, Inc.

15—PORTABLE DIGGER

Is lightweight, economical unit built for one-man operation

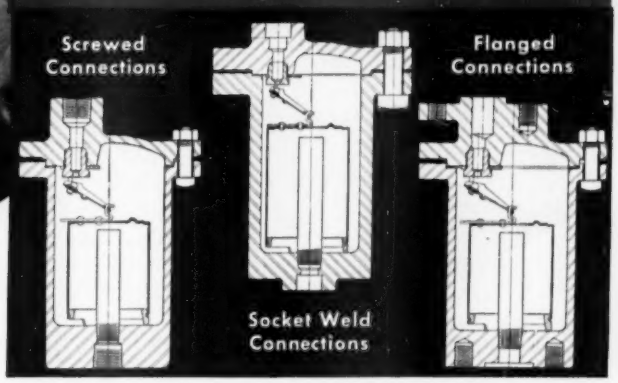
The Hole-A-Minit digs holes ranging from 4 to 11 in. in diameter up to 6-ft deep, and on one model a shaft extension is practical for digging beyond that depth. The tool can be used for digging post holes or in installing or repairing



No. 515 Armstrong trap operating at 875 psig, 910F at West Texas Utilities Co. Lake Pauline Plant

FOR HIGH PRESSURE CONDENSATE DRAINAGE...

(UP TO 2400 LBS.)*



...it pays to use

ARMSTRONG FORGED STEEL STEAM TRAPS!

Because:

1. *They provide dependable automatic drainage* of condensate and boiler carryover for protection of valves, turbines and other equipment.

2. *They have been thoroughly proved* in use in important power plants all over the world.

3. *Armstrong has built thousands of them* since 1929 and has the experience necessary to insure safe design and application. In fact, Armstrong pioneered the development and application of traps for high pressures and has continuously kept pace with the trend to higher pressure plants.

4. *Generous margins of safety are provided,* not only in the forged bodies and caps, but in the power provided for opening the valve and in bucket buoyancy for closing the valve. There is no steam waste and no failure to open.

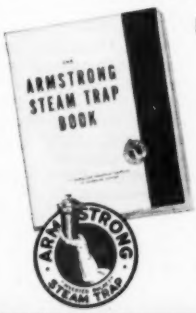
5. *The quality is unsurpassed*—chrome steel valve and seat are hardened, ground and lapped; other working parts are stainless; bodies, caps and bolts and nuts are of materials approved for pressures involved.

6. *The cost is moderate*—first cost because of quantity production, long run cost because of low maintenance.

7. *They are guaranteed to give complete satisfaction.* Your local Armstrong Representative is fully qualified to discuss your forged steel trap applications and to answer your questions. Give him a call, or write:

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

* Many plants, particularly refineries and chemical processing plants use Armstrong forged steel traps at 250 lbs., or less, pressure to secure the advantages of all-steel fittings and freedom from damage in event of fire or explosion.



FOR COMPLETE INFORMATION

Send for the new 44-page Steam Trap Book—includes physical data and list prices, service pressure rating tables, list of materials and other data pertinent to forged steel traps *plus* information on cast traps and trap selection, installation and maintenance for all condensate drainage jobs. Free on request—no obligation.

ARMSTRONG STEAM TRAPS

For more data circle 531 on Post Card

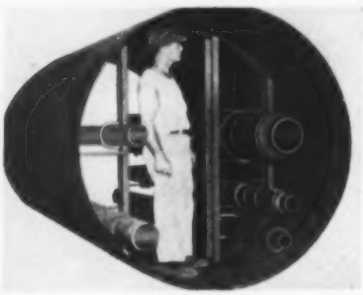
wires. It can be used in remote locations with 1 to 2 kw portable field generators, and is declared practical for drilling at any angle in hard or soft earth or shale. Company says this digger won't bend or break or throw the operator when obstructions are encountered — its hardened carbon steel blades chew up softer shale and ride above large rocks.

All models operate with any air drill equipped with standard Jacobs chuck or with a ½-in. or larger electric drill rated at 500 rpm or less, 7 amp or more. Hole-A-Minits are priced from $14.95 to $53.50. Eugene John Freeman & Co.

16—CONDUIT SYSTEM

Large diameter; for protecting underground piping, utility services

Designed to meet service tunnel requirements of industrial plants, institutions and municipalities, the Utilidor System is prefabricated to job requirements with



distribution piping for steam, condensate, water lines, fire lines or process purposes all in place and insulated where required — including traps, valves and expansion devices. Provision may also be made for electrical and communication cables, ceiling lights. Utilidors are shipped in units about 21-ft long with simple joint connections and fittings prefabricated to fit into the conduit runs.

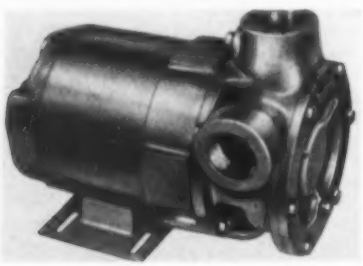
The heavy gage housing is corrugated ingot iron conduit, hot-dip galvanized and treated with protective coatings. Conduit diameters range from 36 to 84 in. The Ric-Wil Co.

17—TURBINE-TYPE PUMPS

In close-coupled design permitting a compact pump-motor assembly

A line of Apco V-Type Close-Coupled Pumps with mechanical seals is announced as available in 3 to 30 gpm capacities and heads to 250 ft. They are available with self priming features where desired.

Company points out that because pump and motor shaft are integral, coupling noise and misalignment troubles are avoided. Four different positions for suction and discharge position afford installation flexibility. Cover, inner ring and impeller are the only wearing parts in the pump, and are made of bronze for



resistance to corrosion. Because they handle vapor entrapped in liquid without losing prime, they will not vapor bind, it is stated. Aurora Pump Co.

18—DESSICANT

Developed for eliminating moisture from refrigerating systems

An-Drite is described as a new moisture absorbent material; it will be used in a new drier, the T-Flo, so named because of its resemblance to the letter "T." An-Drite and the T-Flo Drier are predicted to have important implications, not only for users of refrigeration, but for industries in which excessive moisture affects machine performance.

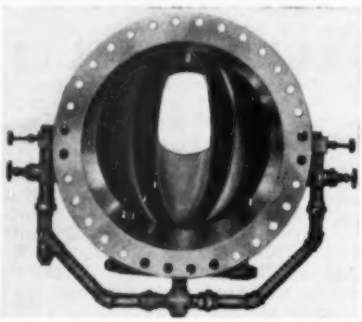
The T-Flo Drier embodies a new design principle, and due to interchangeability of all size driers and connectors, is said to be easily installed and replaced. Connectors do not have to be removed from the line when changing driers. The unit is leak tested with nitrogen at 300 lb pressure. This drier can be installed by standard flare or solder connections.

An-Drite is a chemically treated gelatinous aluminum oxide hydrate in the form of ⅛-in. dia spheres. It is explained that this dessicant does not plug or channel and is efficient up to 140 F; it is non-corrosive, removes acid from refrigeration systems. Ansul Chemical Co.

19—VENTURI TUBE

With elliptical throat, is self-scouring of sediments and solids

A new concept in venturi tube design, the Type VE is intended to solve the specific problems of accurate measurement of low-velocity sewage, sludge and trade wastes under low-pressure condi-



tions. The major dimension of the elliptical throat is vertical and equal to the diameter of the circular main section. This permits a horizontal invert or a flat, straight bottom that is self-scouring. Another feature of the unit is its straight, flat top. This, manufacturer points out, prevents the accumulation of air or gas which could impede liquid flow and enter instrument reading lines and cause faulty readings.

The circular inlet and outlet simplify connections to existing mains. When teamed with a venturi meter, this unit will measure low-velocity, sediment-bearing liquids under a wide range of pressures. Simplex Valve & Meter Co.

20—SOLVENT DEGREASER

Is announced as offering fast cleaning action, high safety factor

A highly concentrated product containing no toxic chlorinated solvents, this degreaser is described as practically nontoxic and non-inflammable and safe to use without special safety clothing or ventilating equipment. Manufacturer suggests it for all degreasing and cleaning operations, pointing out that it acts and dries quickly, is well suited for use where speed is essential and particularly efficient for cleaning electrical motors because it has no adverse effect on electrical insulation. It is said to be economical to use, low in cost; it comes in 5- to 55-gal drums. Brulin & Co., Inc.

21—STEAM TRAP

Side-inlet side-outlet type with 1- or 1¼-in. threaded connections

The No. 814 Trap is designed to meet the demand for a larger size trap with horizontal and opposite pipe connections. Body and cap are cast semi-steel; valve and seat are hardened chrome steel, and interior trim is stainless steel. Capacities of the trap range up to 6800 lb-hr, depending on the pressure, and the pressure range is 0 to 250 psi. The trap is 13⅝ in. high, 9 in. in diameter; it weighs 45 lb. Additional data is offered. Armstrong Machine Works.

22—TESTING METHOD

Is simple means of determining dissolved solids in boiler water

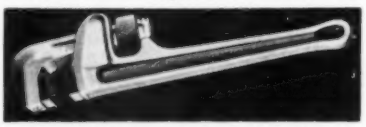
Declared comparable in accuracy and simplicity to the condumetric method, this test involves mixing the boiler water sample with a strongly alkaline anion exchange resin, and titrating a portion of the resulting solution with acid to the proper endpoint.

A milliequivalent of hydroxide is formed for every milliequivalent of salt in the sample, it is explained, and the volume of standard acid needed for titration, multiplied by a suitable factor, gives a measure of the dissolved solids. Two procedures are announced: With the 2-min "dropper test" results are reproducible to 200 ppm dissolved solids. The more precise "burette test" takes 3 min to give results to within 25 to 30 ppm. Test units with enough reagents for about 100 tests are available. Hall Laboratories, Inc.

23—PIPE WRENCH

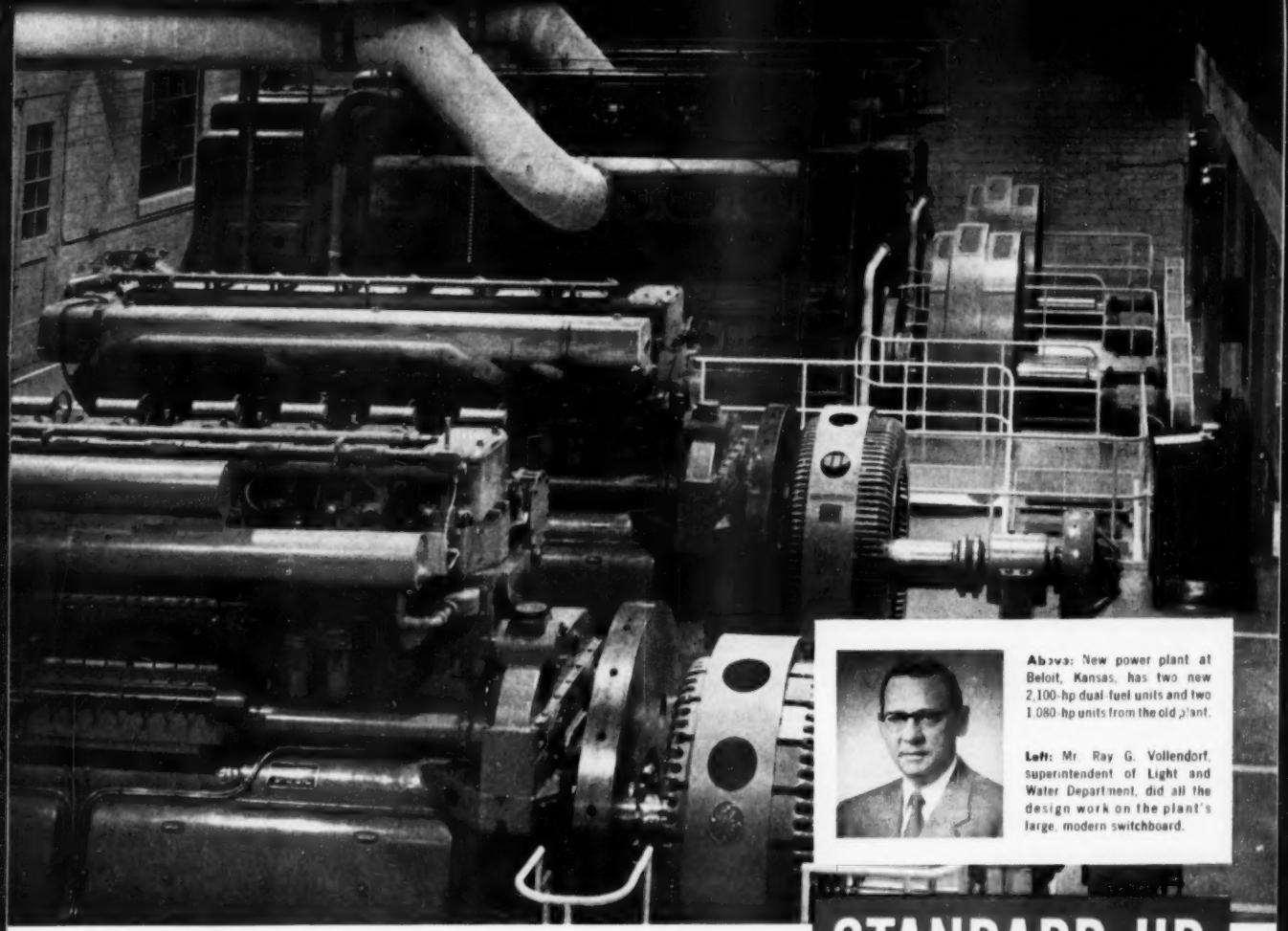
Of light weight aluminum alloy with beryllium-copper jaw inserts

Forged of an aluminum alloy, this spark-resistant wrench is said to possess a dense uniform grain structure with excellent physical properties. Its tensile strength is declared comparable to that of steel tools. Weight of this extremely



light wrench ranges from 15 oz for the 10-in. size to only 8 lb for the 36-in. size.

As an economy feature the beryllium-copper jaw inserts are removable and interchangeable. When the teeth become worn, the insert can be taken out and a new one ordered from stock. Steel jaw inserts can also be furnished where the spark-resistant, corrosion-resistant and non-magnetic properties of the beryllium-copper jaw inserts are not required, it is announced. Ampco Metal, Inc.



Above: New power plant at Beloit, Kansas, has two new 2,100-hp dual-fuel units and two 1,080-hp units from the old plant.

Left: Mr. Ray G. Vollendorf, superintendent of Light and Water Department, did all the design work on the plant's large, modern switchboard.

STANDARD HD
TRADE MARK
OIL

New Beloit, Kansas, plant gets record low maintenance with...

● Acclaimed as one of the municipal showplaces of the Midwest, the new power plant at Beloit, Kansas, is going itself one better in actual performance.

The decision of Mr. Ray Vollendorf, plant superintendent, and city officials to switch to dual-fuel operation has paid dividends. Dual-fuel operation of the two new 2,100-hp units and a 1,080-hp converted unit has reduced fuel cost per kilowatt hour by more than 50%.

Another decision has brought its reward. To STANDARD HD Oil went the job of lubricating the plant's four diesels. Now, after nearly two years' operation, Mr. Vollendorf reports that crankcases are as clean as the day the diesels were placed in service. No rings or bearings have needed to be replaced. Visibility of tool marks on the rings and the over-all excellent condition of the engines indicate that many more hours of service are possible before any overhaul or replacement of parts will be required.

Including the two years' operation of the new plant, the experience of Beloit, Kansas, municipal officials with Standard Oil products covers 20 years. That experience testifies to the satisfaction and benefits you'll realize through Standard Oil's high quality products and outstanding service. You can reach the Standard lubrication specialist in your area of the Midwest by phoning your local Standard Oil office. Or, write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

STANDARD OIL COMPANY STANDARD *(Indiana)*

For more data circle 532 on Post Card

POWER PLANT Construction News

Osceola, Ark. — Crompton-Shenandoah Co., Waynesboro, Va., bleaching and finishing of pile fabrics, plans boiler plant at new mill at Osceola, to be used for corduroy finishing. It will comprise several buildings and is reported to cost over $750,000. Work will proceed at early date.

Ozark, Ark. — Arkansas Electric Cooperative Corp., Ozark, has plans for new steam-electric generating station near Ozark, to be equipped for an initial capacity of 30,000 kw. Proposed to begin work soon. No official estimate of cost announced.

Johnstown, Colo. — Great Western Sugar Co., Sugar Bldg., Denver, Colo., beet sugar products, plans boiler house at new mill at Johnstown for processing and production of glutamate, a by-product of beet sugar manufacture. It will consist of several buildings and will represent a reported investment of $2,500,000.

Southbury, Conn. — Electric Power, Inc., subsidiary of Connecticut Light & Power Co., Hartford, Conn., has secured permission to proceed with construction of new hydroelectric power plant on Housatonic River, near Southbury, including power dam to form a lake of about 1870 acres, generating station, switching station and other structures. Entire project will cost about $13,-000,000.

Fernandina Beach, Fla. — Container Corp. of America, Inc., 36 South Dearborn St., Chicago, Ill., plans boiler house at new corrugated paper container plant at Fernandina Beach. It will be equipped for large output. Cost reported about $1,000,000.

Pensacola, Fla. — Gulf Power Co., is arranging for financing in amount of $7,000,000, through sale of bond issue, portion of proceeds to be used for extensions and improvements in power plants and system, including increased generating facilities, power substations, transmission lines, etc.

Connersville, Ind. — Rex Mfg. Co., Division of Philo Corp., Connersville, electric refrigerators, plans power house at new local plant, comprising several buildings, to be equipped for large capacity. Cost reported about $4,000,000. Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich., is architect and engineer.

Kansas City, Kan. — Western Light & Telephone Co., Huron Bldg., has arranged for an expansion and improvement program in generating plants, transmission and distributing lines, power substations and other operating facilities in 1953 to cost about $7,000,000.

Louisville, Ky. — Ford Motor Co., 3000 Schaefer Hy., Dearborn, Mich., is having plans prepared by Albert Kahn Associated Architects & Engineers, Inc., New Center Bldg., Detroit, Mich., architect and engineer, for proposed new assembling plant at Louisville, recently noted in these columns. It will total over 1,000,000 sq. ft. floor space. A power house will be built. Entire project reported to cost close to $40,000,000. Work expected to begin soon.

Cumberland, Md. — Potomac Electric Power Co., Hagerstown, Md., is arranging fund of $23,000,000, to be used for expansion and improvements in power plants and system during present year, including increased generating capacity, power substations, transmission lines and other operating facilities.

Natick, Mass. — Bd. of Selectmen, Town Hall, is considering a new municipal boiler plant for central-heating service. Estimates of cost are being made.

Detroit, Mich. — Part of the Ford Motor Company's extensive modernization program, the Number One Power Plant at River Rouge is undergoing complete modernization. When the project is finished, this plant will be the largest private industrial power plant in the world. Three medium-pressure boilers are currently being removed and replaced by new boilers with 600,000 lb per hr continuous steam capacity. The Kuljian Corp., Philadelphia, are in charge of design, engineering and construction. Boiler demolition has recently been completed, and the installation of new units will be completed by February, 1954.

Livonia, Mich. — Chevrolet Motor Co., Division of General Motors Corp., plans power plant at new works at Livonia, for manufacture of springs, bumpers and allied products. It will comprise several large buildings and is estimated to cost close to $7,500,000. Albert Kahn Associated Architects & Engineers, Inc., New Center Bldg., Detroit, Mich., is architect and engineer.

River Rouge, Mich. — Detroit Edison Co., Detroit, Mich., has approved plans for new generating station at River Rouge, with installation to consist of two 260,000-kw. turbine generators, high-pressure boilers and auxiliary equipment. Entire project reported to cost in excess of $25,000,000, with transmission lines, power substations and other operating facilities. Proposed to begin work early in 1954.

Columbus, Miss. — American Bosch Corp., 3664 Main St., Springfield, Mass., automotive and aircraft electrical equipment, etc., plans boiler house at proposed new branch plant at Columbus, where site has been secured. Cost reported close to $1,000,000. Lawrence S. Whitten, Brown-Marx Bldg., Birmingham, Ala., is architect.

Gulfport, Miss. — Mississippi Aluminum Corp., subsidiary of Sherman-Manson Corp., St. Marys, Ohio, (furniture), plans boiler house at new plant at Gulfport, to be equipped for manufacture of aluminum tubing. It will consist of several units, and is estimated to cost about $1,500,000. Shrouds & Magabgab, Gulfport, are architects.

Omaha, Neb. — Continental Can Co., 100 East 40th St., New York, N. Y., tin and other metal containers, etc., plans boiler plant at new factory at Omaha. Work will be placed in progress soon. It will comprise several large one-story buildings. Cost estimated over $2,000,000.

Littleton, N. H. — New England Power Co., 441 Stuart St., Boston, Mass., has engaged Ebasco Services, Inc., 2 Rector St., New York, N. Y., engineer and contractor, to design and supervise construction of new hydroelectric generating plant at Fifteen Mile Falls on Connecticut River, near Littleton. Installation will consist of a number of hydraulic turbines and electric generators, with auxiliary equipment. Entire project reported to cost in excess of $40,000,000.

Portsmouth, N. H. — U. S. Engineer Office, 857 Commonwealth Ave., Boston, Mass., plans new boiler plant for central-heating service at Air Force Base at Portsmouth. Cost estimated about $1,000,000. Proposed to begin work soon.

Mahwah, N. J. — Ford Motor Co., 3000 Schaefer Blvd., Dearborn, Mich., plans new car and truck assembling plant in vicinity of Mahwah, where tract of about 200 acres of land has been acquired. A power plant is planned. Main production building will approximate about 1,500,000 sq. ft. floor space. Entire project will represent a reported investment in excess of $35,000,000.

Troy, Ohio — Municipal Electric Dept., plans extensions and improvements in municipal steam-electric generating station, with installation of new boiler, stoker, coal conveyor and other equipment. Entire project is estimated to cost close to $1,000,000.

Oklahoma City, Okla. — Oklahoma Gas & Electric Co., will make extensions and improvements in power plants and system to cost $11,900,000, over a period of months, including increased generating facilities, power substations, transmission lines and other work.

Philadelphia, Pa. — National Biscuit Co., 449 West 14th St., New York, N. Y., plans boiler plant at proposed new bakery on Roosevelt Blvd., Philadelphia, where large tract of land has been purchased. It will consist of a main one-story structure and several smaller units. Cost reported close to $10,000,000. Completion is scheduled late in 1954.

Reading, Pa. — Metropolitan Edison Co., 412 Washington St., has disposed of a bond issue of $8,000,000, majority of proceeds to be used in connection with 1953 expansion program, covering generating stations, power substations, transmission lines and other operating facilities.

Abilene, Tex. — West Texas Utilities Co., Third St., is arranging for financing in amount of $5,500,000, large part of proceeds to be used in connection with current expansion and improvement program, covering increased generating capacity and other operating facilities. As previously announced, company will expand local power plant.

Dallas, Tex. — Texas Power & Light Co., has arranged for sale of a bond issue of $5,000,000, proceeds to be used in connection with expansion and improvements in power plants and system in 1953.

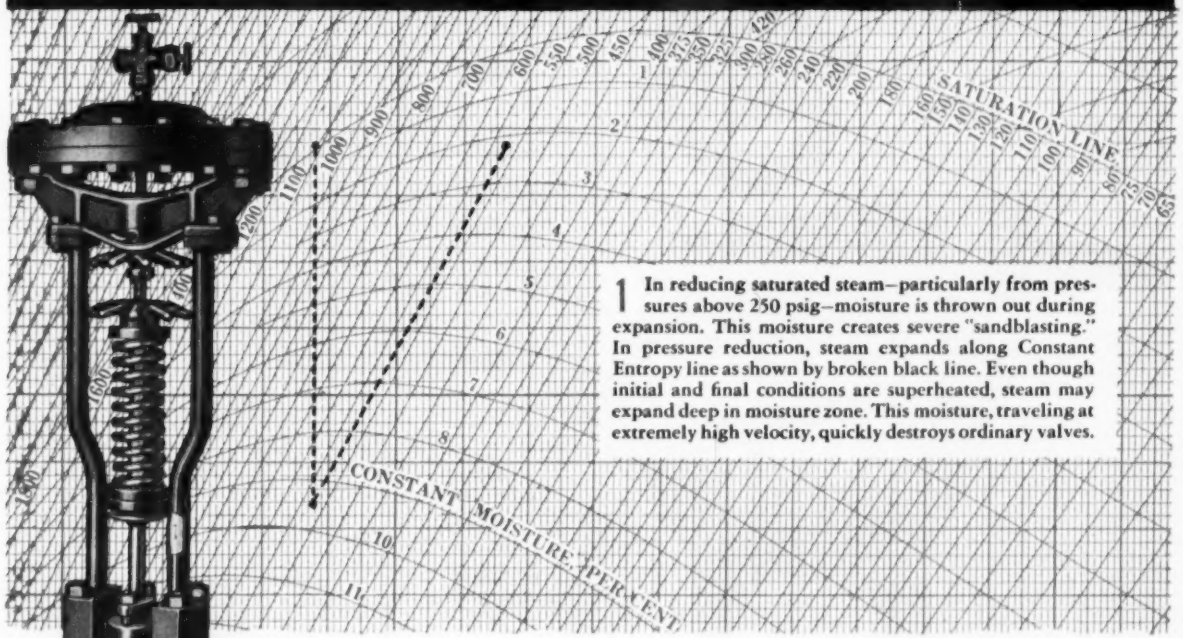
Denver City, Tex. — Southwestern Public Service Co., Amarillo, Tex., has approved plans for expansion in steam-electric generating station at Denver City, with installation of new turbine generator, high-pressure boiler and auxiliary equipment. Cost about $7,500,000. Work will be placed under way at early date.

Longview, Tex. — Eastman Kodak Co., Kodak Park, Rochester, N. Y., plans power house at proposed new plastic products plant at Longview, where site has been selected. It will comprise several large buildings, equipped for rated output of 20,000,000 lbs. per annum. Cost reported in excess of $3,000,000.

Portsmouth, Va. — Virginia Electric Power Co., 7th and Franklin Sts., Richmond, Va., will proceed with work on second unit of new steam-electric generating plant at Portsmouth, previously referred to in these columns. Initial unit of 110,000-kw. rating recently was placed in service. New generator and auxiliaries will have a similar rating, and is estimated to cost close to $15,000,000, developing a total cost of approximately $33,000,000 for new plant. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer.

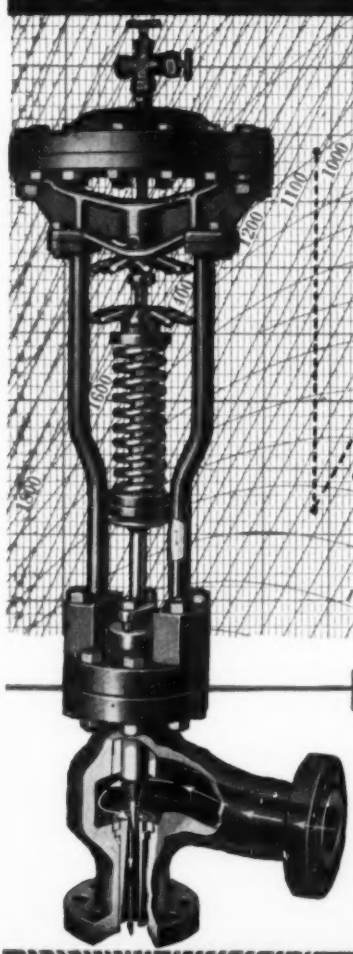
Eau Claire, Wis. — Northern States Power Co., will carry out extensions and improvements in properties to cost about $1,500,-000, including power plant, power substations, transmission lines and other operating facilities.

Swartwout V-10 Flow Regulating Valves slash maintenance costs in systems with high pressure drop or flashing condensate



1 In reducing saturated steam—particularly from pressures above 250 psig—moisture is thrown out during expansion. This moisture creates severe "sandblasting." In pressure reduction, steam expands along Constant Entropy line as shown by broken black line. Even though initial and final conditions are superheated, steam may expand deep in moisture zone. This moisture, traveling at extremely high velocity, quickly destroys ordinary valves.

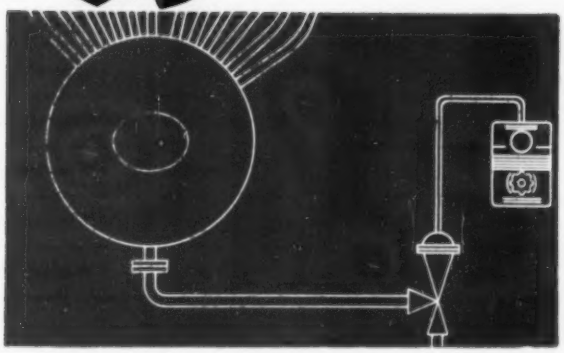
Chart from *Thermodynamic Properties of Steam* by Keenan & Keyes. Reproduced by permission of John Wiley & Sons, Inc., Publishers



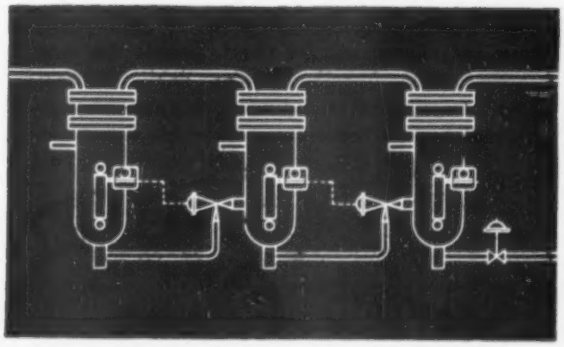
2 Swartwout V-10 valves are scientifically designed to handle liquids at high pressure drops and also under *flashing conditions.* All direct impingement is eliminated and longer valve life is assured two ways—by better flow design, plus use of materials specifically selected for the service involved. As a result, ***Swartwout V-10 valves outperform other valves in similar service.***

Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION



3 High pressure boiler blowdown service is extremely rigorous. When closed, there is full pressure drop across valve; when open, high velocities and flashing rapidly increase line loss and decrease the allowable drop across the valve. The variations in pressure make this service critical since valve must handle all conditions.



4 In saturated liquid drainage service, such as on high pressure extraction type heaters, water at saturation temperature flashes into steam when pressure is reduced. Exclusive scroll inlet and gradually expanded straight outlet of V-10 valve design permit a sliding action instead of direct impingement thus preventing corrosion-erosion. A-4208

SEND FOR BULLETIN S-208N • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

For more data circle 533 on Post Card

Ready FOR ANY FUEL JOB

There's never any need for compromising on the fuel properties you require for your particular combustion job, when you use Beacon Coal. You'll find, in this comprehensive line, a fuel that's exactly suited to each application: domestic hand and stoker fired; commercial hand or stoker fired; general industrial; electric utilities; railroad; steamship bunker; coke and gas plants; and special uses. Mine locations and shipping facilities, as shown on the chart, permit the most advantageous distribution. And finally, the conveniently located sales offices bring the able services of Beacon representatives within easy reach.

NAME OF COAL	CHARACTER	MINE
Sonman	Central Pennsylvania Low Volatile	Sonman
Indian Creek	Central Pennsylvania Medium Volatile	Melcroft
Federal	Northern West Virginia	Federal #1
Bergoo		Bergoo #2
		Bergoo #4
		Bergoo #6
Bolair		Bolair
Beckley	Southern West Virginia Low Volatile	Eccles #5
Sewell		Eccles #6
New River		Helen #9
		Stotesbury #8
		Stotesbury #11
Pocahontas		Keystone
		Maitland
Beckley	Southern West Virginia and Eastern Kentucky High Volatile	Beards Fork
		Page
		Kopperston #1
Nos. 2 Gas		Kopperston #2
Wharton		Wharton #1
		Wharton #2
Weeksbury		Weeksbury

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"E"	Cambria (Pa.)	Penna.	1	Egg; Stoker; M/R; N&S; Slack	2500	Sa[illegible]an
"B" or Miller	Fayette (Pa.)	B & O	1	M/R; N&S; Slack	1200	Indi[illegible] Creek
Pittsburgh	Marion (W. Va.)	Monongahela; B&O	3	Lump; Egg; Nut; Stoker; M/R; N&S; Slack	10,000	Fe[illegible]al
Sewell	Webster (W. Va.)	Western Maryland	3	M/R	1500	
Sewell	Webster (W. Va.)	Western Maryland	3	Lump; Egg; Nut; Jr. Egg; M/R; N&S	1600	Be[illegible]oo
Sewell	Webster (W. Va.)	B & O	3	M/R	1000	
Fire Creek	Webster (W. Va.)	B & O	3	Egg; Nut; M/R; N&S	2000	Be[illegible]r
Beckley	Raleigh (W. Va.)	C&O; Virginian	7	Egg; Stove; Nut; N&S; Slack	2500	Be[illegible]ey
Sewell	Raleigh (W. Va.)	C&O; Virginian	7	M/R; N&S; Slack	1000	Se[illegible]ell
Pocahontas #3	Raleigh (W. Va.)	C&O; Virginian	7	Stove; Nut; N&S; Slack	2500	
Pocahontas #4	Raleigh (W. Va.)	C&O; Virginian	7	Stoker; M/R; Slack	2000	New [illegible]ver
Pocahontas #4	Raleigh (W. Va.)	Virginian	7	M/R; Slack	1800	
Pocahontas #3	McDowell (W. Va.)	N & W	7	Egg; Stove; Nut; Stoker; M/R; N&S; Slack	5000	Poca[illegible]ntas
Pocahontas #4	McDowell (W. Va.)	N & W	7	Stoker; M/F, Slack	1500	
Eagle	Fayette (W. Va.)	Virginian	7	M/R; N&S	1500	
Eagle	Fayette (W. Va.)	Virginian	7	M/R; N&S	1000	E[illegible]gle
Eagle	Wyoming (W. Va.)	Virginian	8	M/R; N&S; Slack	3500	
Campbells Creek	Wyoming (W. Va.)	Virginian	8	M/R; N&S; Slack	4000	No. [illegible] Gas
Hernshaw	Boone (W. Va.)	C & O	8	Lump; Egg; M/R; N&S	3500	Wh[illegible]on
Hernshaw	Boone (W. Va.)	C & O	8	M/R; N&S	3000	
Elkhorn #3	Floyd (Ky.)	C & O	8	Block; Egg; M/R; N&S; Slack	1000	We[illegible]bury

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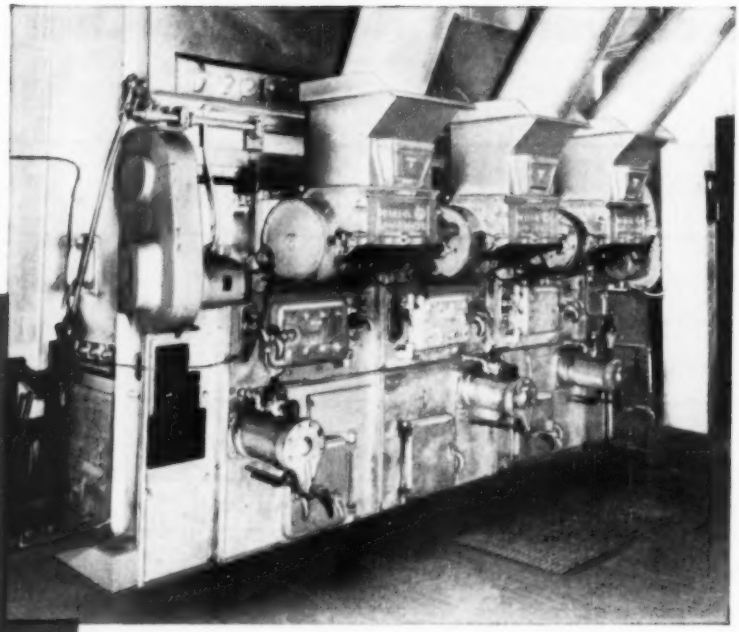

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LETTERS TO THE EDITORS

Duval Approves Condor Juan

WITH GREAT PLEASURE I read the article in the March issue entitled "Here and There with Condor Juan."

We who live and work in the power plant industry outside of the U. S. A. can surely appreciate that article.

As he says, we are accustomed to call "experts" all those who come to us from there in construction or renovation of power plant equipment. But I have had experience with some, especially young men just out of college with a brand new engineering degree, who think they have all the answers and we know nothing.

Not all, however. Some of the older men I have known, like Condor Juan, are *really* expert in their field and I have learned very much from them. Also we have been very good friends both inside and outside the power plant for I have always tried to facilitate their work in every way I could; and after work I have been able to help them as interpreter.

As regards power plant literature, it would be a good idea if more of it were printed in Spanish as well as English but personally this does not bother me, because all my life I have spoken and written both languages with equal fluency.

Incidentally this has always made my engineering services more valuable to my employers, because I can read POWER ENGINEERING, the ads as well as the text, and write to manufacturers and receive information from them that may avoid costly errors in the purchase of equipment needed.

L. RENE DUVAL

Ciudad Trujillo, R. D.

Editor's Note: — Mr. Duval is power plant engineer of Fabrica Dom de Cemento in the Dominican Republic.

Figuring Steam-Water Mixtures

Hard Way or Easy Way?

MR. ENGELMAN'S article, March 1953, page 77, makes things entirely too hard. First, he fails to point out that the Keenan and Keyes *Steam Tables* give the enthalpy of ice — Table 5 — as well as that of water and steam.

But his big error is in saying "The general laws of thermodynamics cannot be readily applied in the case of mixtures."

Fact is that the easiest way to solve mixing problems is by the application of two general laws, conservation of mass and conservation of energy. These become:

Weight in = weight out (1)

Enthalpy in = enthalpy out (2)

If there is any heat loss from the apparatus, we have to add a term "heat out" on the right side of Eq. (2). However, our apparatus is generally adequately insulated.

Putting in algebraic terms, these equations become:

$w_1 + w_2 + w_3 \ldots = w_a + w_b \ldots$ (3)

$w_1h_1 + w_2h_2 \ldots = w_ah_a + w_bh_b \ldots$ (4)

All the author's problems can be solved by these two equations, thus:

Problem	Given	To Find
1, 2, 4, 5, 6, 7, 8	w_1, w_2, h_1, h_2	w_a, h_a
3	w_1, w_2, h_1, h_a	w_a, h_2
9	w_1, h_1, h_2, h_a	w_2, w_a
10	w_a, h_1, h_2, h_a	w_1, w_2
11	$w_1, w_2, w_3, h_1, h_2, h_3, h_a, h_b$	w_a, w_b
12	$w_1, w_2, w_3, h_1, h_2, h_3$	w_a, h_a
13	$w_1, w_2, w_3, w_c, h_1, h_2, h_3, h_a, h_b, h_c$	w_a, w_b

To show the relative simplicity of the methods, we give the solution of the author's problem 11.

w_1	100	$h_1 = 1317.0$	$w_1h_1 = 131,700$
w_2	70	$h_2 = 28.0$	$w_2h_2 = 1960$
w_3	30	$h_3 = -157.0$	$w_3h_3 = -4710$
	200		128,950

average h = 128,950 ÷ 200 = 644.8 Btu per lb

This is more than the enthalpy of water, and less than the enthalpy of steam at 33 psia. Therefore, we have some of each. Using subscript a for steam and b for water,

$w_a + w_b = 200$

$w_a \times 1166.0 + w_b \times 224.4 = 128,950$

Solving, $w_a = 89.3$ lb and $w_b = 110.7$

If the author would divide by the latent heat at 33 psia, 941.6 Btu per lb, instead of 1092.59, he would get the right answer. His method is not wrong; I merely claim that it obscures a relatively simple problem.

If we get into mixing problems where pressures are involved, we have to look out for the second law of thermodynamics, but that difficulty does not arise here.

G. M. DUSINBERRE

State College, Penna.

Editor's Note: G. M. Dusinberre is the well-known professor of mechanical engineering at the Pennsylvania State College School of Engineering. He raises here an important point in calculating mixtures of steam and water. But, in Mr. Engelman's reply to it given below, another important point is raised: that Mr. Engelman's method is based on his experience in making things clear to his classes of operating men with little training in mathematics. This was explained at the beginning of the Basic Power Plant Figuring series, but perhaps deserves re-emphasis now. But let Mr. Engelman do it.

Engelman Aims at Operating Men

PROF. DUSINBERRE'S interest and comments are very much appreciated. His suggestions and criticism are constructive and worthwhile.

However, there is a major difference in the viewpoints from which college students, on the one hand, and operating personnel, on the other, learn thermodynamics. College thermodynamics most commonly begins with the general energy equation. This equation is memorized, as of course it must be. It is not serious to the student if he does not have a perfectly clear picture of certain processes; as long as he can handle the algebra, he will not do too badly on problems. In the usual sequence, the remainder of the course explains the application of the general energy equation to various real situations. Even the law of the reversible adiabatic process

$$P V^k = C$$

is developed in this manner. Most college students are not familiar with feedwater heaters, boilers, and the like, and the mathematics is to them the more familiar ground. As the course progresses, the terms which are deleted for each type of problem can be learned.

On the other hand, to a man making his living in a boiler plant, the familiar and understandable ground is a clear picture of steam condensing in the feedwater heater he works around each day. Mathematics is, in general, a foreign language. Many operators have not reached high school.

Experience in the training of operating personnel shows that the method used in working the problems on which Prof. Dusinberre has commented is understandable to them. These problems are intended to explain the physical processes, as well as indicate a method of calculation. The clear physical picture is an absolute necessity, and without it, no method is useful. College students, by contrast, are accustomed to investigating the physical significance of a derived mathematical expression.

In the problem cited by Prof. Dusinberre, for example, part of the apparent complexity is the evaluation of individual state changes. This places the student upon solid ground. Otherwise, the values obtained from the tables, and the calculations themselves, are not much different.

Prof. Dusinberre is quite right in calling attention to Table 5 of Keenan and Keyes *Steam Tables*. It has been found that a "negative enthalpy" is somewhat less clear than treatment of ice by using specific heat. The tabulated values are, of course, more accurate.

It is true that Prof. Dusinberre's method is in many cases simpler to use than the method shown by the author. However, this author's method has worked in apprenticeship training, largely because it does not require much background.

Cleveland, Ohio WM. H. ENGELMAN

Steam from Steel

Blast-furnace gas, once a wasted by-product, is now the main fuel for steam and power generation in many steel works. Here's how power plants are built to burn it

By
ROBERT W. WORLEY
and
HAROLD J. BENTSON
Supervising Engineers
United Engineers & Constructors, Inc.

WASTE or by-product fuels available in steel works are the principal reason for the existence of their large power plants. There is enough potential heat energy in waste fuels to generate all power and steam requirements after satisfying every other practical use; in a plant that produces its own coke and operates its own blast furnaces, however, there are practical limitations to such utilization.

For every ton of coke produced, there will be about 8,000 cu ft of surplus gas with a heat content approximately 550 Btu per cu ft, 145 lb of coke breeze with a heat value of approximately 11,000 Btu per lb and 13 gal of tar with a heat value of 160,000 Btu per gal.

The blast furnace is the largest producer of waste heat, issuing approximately 100,000 to 150,000 cu ft of gas with a heat value of about 90 Btu per cu ft for every ton of iron produced. Twenty-five to thirty per cent of this is used to preheat air used in blowing furnaces and in losses, leaving 70 to 75 per cent or 6,000,000 to 9,000,000 Btu available for other uses, including underfiring of coke ovens, operating internal combustion engines, and/or fuel in steam generating units. Blast-furnace gas should be an excellent fuel for gas turbines and this type of drive no doubt will come into use in steel works as their development progresses.

These figures are approximate, and represent limits that might be met in the usual steel works. They demonstrate that there generally is waste heat energy available for the production of 4500 to 6500 lb of steam per net ton of iron tapped. Roughly, 1000 to 1300 lb of steam will be required to operate air blowing equipment for blast furnaces. Other plant uses may require 2000 lb leaving 1500 to 3500 lb of steam per net ton of iron for electric power generation. This will produce 220 to 450 kwh per net ton of iron. The electric power requirements of steam works vary widely, depending on final product and degree of reduction and finishing, but generally would not exceed these values.

Condensing Water Supply

The steel works power plant presents problems not ordinarily encountered in utility work. The majority being built at present are in existing mills and the space available is usually very limited. The plant should be reasonably close to the blast furnaces partly because long gas pipes are inconvenient and expensive. Also, the turboblowers should be in the same building with, or at least adjacent to, the turbogenerators. This leads to better supervision and labor economy. These conditions leave little latitude in the selection of a suitable site for the power plant.

Provision of a proper supply of condensing water often presents a real problem. Many plants are on streams with small flows, so small in fact, that the entire stream flow may have to be used in series through condensers and thence into the mill to supply the large quantities of cooling and wash water required. In some cases cooling towers have been used to advantage.

The burning of blast-furnace gas presents peculiarities somewhat different from those with coal or other richer fuels. Because of the low combustible content per cu ft of gas, boiler furnaces must be large in order to allow time for complete mixture of gas and combustion air. Blast-furnace gas boiler furnaces should probably be designed for combustion rates not much over 18,000 Btu per cu ft, though there are installations operating at considerably higher rates. Furnace temperatures are considerably lower than with coal, oil or natural gas and more heat absorbing surface is necessary. Burners must be designed to produce turbulence and as intimate a mixture of gas and air as possible.

The gas, as it leaves the blast furnace top, is heavily loaded with dust, mostly iron oxide. Some of the dust is removed in "dust catchers" and in many plants it is further cleaned in wet scrubbers of various types. Practically all modern installations include electrostatic precipitators which remove nearly all dust from the gas. However, even with precipitation there is apt to be trouble with ferrous slag accumulations on the boiler tubes and usually the spacing of the first pass tubes nearest the furnace is increased to minimize this difficulty.

The distribution of blast-furnace gas calls for very large pipes to handle the volumes needed at the low

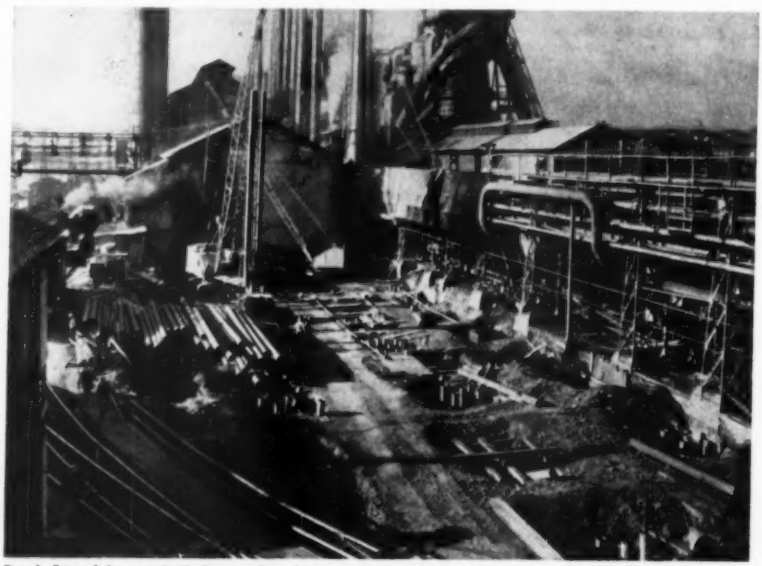


Fig. 1. Site of the new boilerhouse after clearing, showing the awkward situation in which it had to be built

available pressure, and there must be provision for cleaning while in service, usually by washing. Design of the pipes and pipe supports must allow for a heavy dirt accumulation. Because the gas is both explosive and poisonous, means for purging must be installed. Steam is generally used for this purpose with the result that thermal expansion of the gas mains must be considered.

A recent installation in the Great Lakes area illustrates some of the conditions encountered in steel works power developments.

New steam generating facilities were required to replace old boilers for which the boiler inspector ordered drastic pressure reductions if continued in service. No clear space was available for the new house at a suitable location; however, a possible area adjacent to the blast furnaces was developed by demolishing several service shops. Fig. 1 shows this site after cleaning and during pile driving operation.

This site was far from ideal, with hot metal tracks on both sides and along the north side a maze of existing blast furnace gas and cold blast mains and other piping which could not be moved. The hot metal track along the south side could not be relocated due to the blast furnace office building. By careful arrangement and attention to size of equipment purchased it was possible to develop a satisfactory layout. The north building column line was located as close to existing pipe supports as possible and still permit driving piles. Induced draft fans on south side were located with a bare minimum of legal clearance from center of the hot metal track. Fig. 2 shows the completed boiler house.

Figure 3 shows the layout of the new boiler house with two new boilers, auxiliaries, and provision for a third unit. Two single pass boilers each having a capacity of 220,000 lb per hour at 900 psi 850 F are installed. Each boiler is equipped with six burners arranged to burn blast-furnace gas, coal, or coke oven gas. Each burner has continuous burning coke oven gas pilots. The boilers are equipped with air heaters.

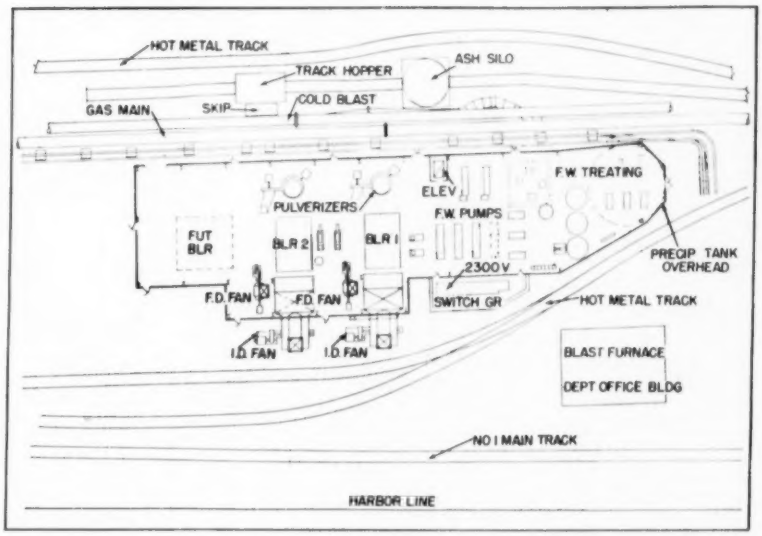


Fig. 3. Showing layout of the new boilerhouse, with the two new boilers and provision for a future third unit

Feedwater Equipment

The feedwater equipment is a hot process, hot-zeolite-softener system. It was placed in the east end of the building as this equipment could be arranged to permit tapering the building as dictated by the location of the hot metal track. The sedimentation tank was erected outdoors and above the one story section of the building enclosing the ground floor area where the zeolite softeners and pumps are installed. Six softeners were required for desired capacity but space was not available to place them all at floor elevation, consequently they were double-decked. This arrangement is satisfactory for operation but adds some difficulties to the operator's duties due to valves at two platform levels.

Figure 7 shows a cross section of this building and equipment. Existing blast furnace gas, cold blast, and other piping is so close to the building that a track for coal and ash cars and the track hopper had to be located beyond them. The skip hoist for coal handling rises vertically beyond the existing piping and then breaks back as soon as possible to enter a penthouse on the top of the building. Ordinarily, run-of-mine coal is purchased for the plant so a coal crusher was installed at the top of the house. Coal from the crusher is distributed by belt conveyor to individual bunkers for each boiler.

Blast-furnace gas is distributed from blast furnaces to boilers by new gas piping installed above the existing lines north of the building. The gas will be cleaned by three electrostatic precipitators each having a capacity of 67,000 cfm. Space for this installation was not available adjacent to the boiler house, so the precipitators were erected on the site of five of the old boilers which could be dismantled only after the new boilers were in operation on coal.

A new 20,000 kw hydrogen cooled turbinegenerator was installed, taking steam at 850 psi 850 F and exhausting at 200 psi. Space for this unit was available in a building which originally housed vertical steam driven blowing engines and in which two turboblowers are now located.

Turbinegenerator Installation

Installation of the turbinegenerator in this building required a steam line from the boiler house header, a distance of approximately 700 ft. For this steam pressure and

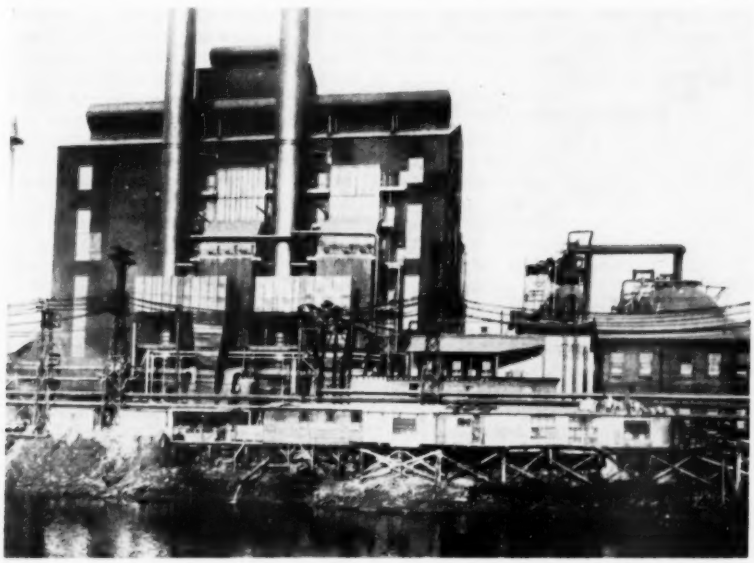


Fig. 2. Shows view from the harbor side of the completed boilerhouse located next to the blast furnaces

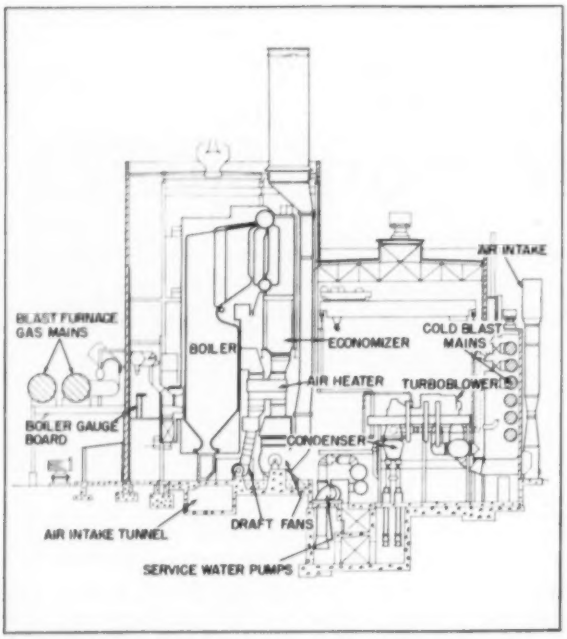


Fig. 4. Turbine room extension; single pass boiler reduces high draft losses

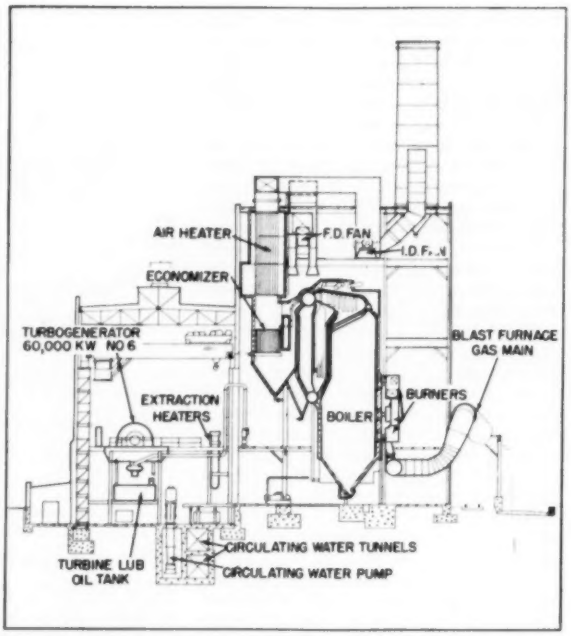


Fig. 5. Turbinegenerator extension, showing one of two 10 ft dia. gas mains

temperature chrome-molybdenum alloy steel pipe was used. It was found more economical to run two 14 in. pipes rather than one 18 in. This had an added advantage of lower velocity and consequent lower pressure drop. A short section of single 16 in. pipe to carry the entire steam flow to the turbogenerator was introduced to insure an even temperature of steam to the two separate throttle valves with which the unit is equipped.

Steel Power Plant

Figure 6 is a general plan of one of the largest power plants in the steel industry. Typical of many steel works plants, it serves both for electric power generation and blast furnace blowing. The total installed steam generating capacity is 1,775,000 lb per hr and the electric power generating capacity 1,890,000 kw. There are five blast furnace turboblowers and three large plant service water pumps, two of which are steam turbine driven.

The first section of the plant was started in 1937. Because "cheap" fuel was available and higher steam pressures and temperatures were not yet generally accepted for industrial plants, steam conditions were limited to 450 psi 750 F. A 25 cycle turbinegenerator of 25,000 kw capacity (rerated 30,000 kw) and three 75,000 cfm, 30 psi turboblowers, together with three 275,000 lb per hr boilers comprised the first step. Evaporators using steam at 450 psi and delivering 150 psi steam for yard service were included. The building allowed space for a future turbinegenerator and one additional boiler. Boilers Nos. 2, 3, and 4 and turbinegenerator No. 7, together with blowers Nos. 1, 2, and 3 were in the original installation.

In 1947 an extension was made which included one 300,000 lb per hr boiler for the original steam conditions and two turboblowers of 110,000 cfm, 30 psi capacity. A building extension was made at this time at the opposite end from the space previously left available. The turbine room extension was made large enough for two future turboblowers. The additional boiler is No. 5 and the blowers are Nos. 4 and 5. Fig. 4 is a cross-section through this addition to the station. The boiler is a single pass unit which is quite effective for blast furnace gas as it minimizes draft loss, which tends to be very high with this fuel. The turboblowers and turbogenerators are at the same level for operating convenience, though the turboblowers with their condensers do not require this basement height.

Blast-Furnace Gas

The most recent addition to the plant included a 60,000 kw preferred standard 60 cycle turbinegenerator and one boiler. When these units were installed the use of blast-furnace gas was much greater than when the original installation was planned, at which time there was not as much excess available. Also at the time of the most recent addition higher pressures and temperatures were generally used and accepted in industrial power plants. For these reasons this installation was designed for 850 psi 900 F at the turbine throttles.

The boiler is the largest blast-furnace-gas-fired boiler ever built, having a capacity of 650,000 lb per hr which is sufficient for the full capacity of the turbogenerator. For blast-furnace gas fuel the furnace volume and the water heating surface are about as large as would be required for an 800,000 lb per hr coal-fired steam generator. The turbogenerator was installed in the space originally planned for a 25,000 kw unit, and it was possible with minor modifications to use the circulating water intake wells and discharge flume already in place. The new boiler is in an extension to the building and the space which in the original design had been left for a future boiler became a feedwater heating and pumping bay. On the plan the boiler is No. 1 and the turbine is No. 6. Fig. 5 is a cross-section of the turbogenerator extension.

The principal fuel is blast-furnace gas with natural gas and oil as supplementary fuels. Natural gas is available only on a "dump" basis. The quantity of blast-furnace gas required for a plant of this size is indicated by the two ten-foot diameter gas mains which supply the station. Provision has been made on all boilers for possible future installation of pulverized coal burning equipment. Should the quantity of supplementary fuel become a large portion of the total, then the normal difference in cost between oil and coal will justify installing coal-firing equipment.

Feedwater Heating Systems

The feedwater heating systems for both the 450 and 850 psi sections of the station are a combination of deaerating type contact heaters and closed extraction heaters. The new unit is equipped with four stages of extraction heating and one deaerating heater. Steam for the deaerator is mostly from boiler feed pump drive exhaust but supplemented by turbine extraction. Makeup for the

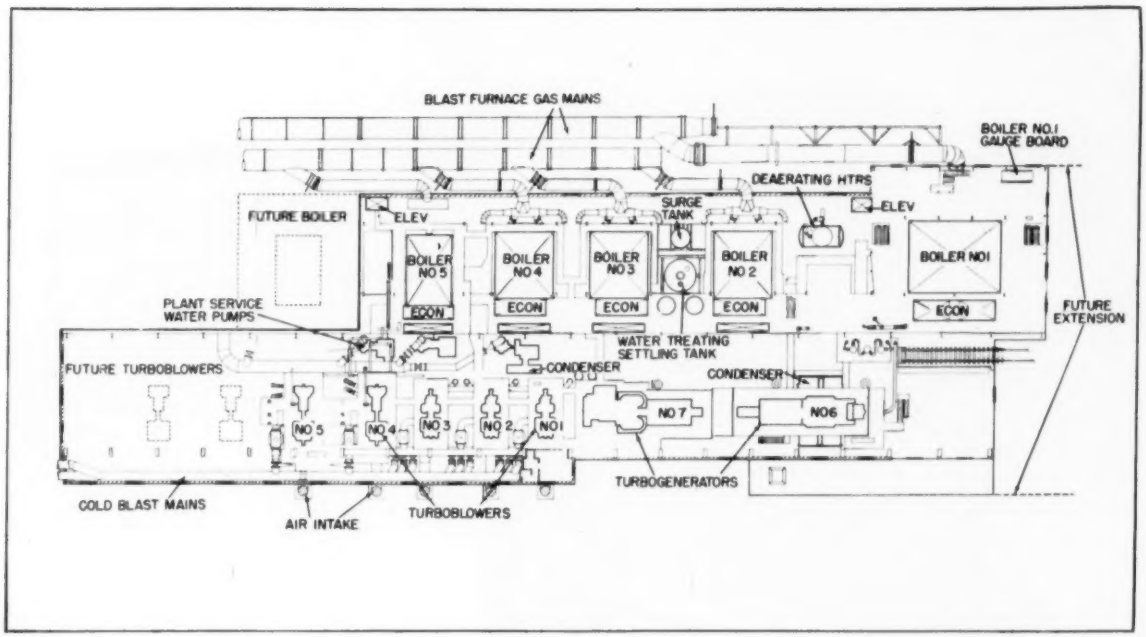


Fig. 6. Layout of a large steel works power plant, with a steam generating capacity of 775,000 lb per hr and electric power generating capacity of 90,000 kw

850 psi system is through condensation in the deaerator of the exhaust from a turbine which drives a station service water pump and uses 450 psi steam. In the 450 psi section some draft fans and feed pumps are steam driven and the exhaust is sufficient to heat feedwater to about 215 F in a deaerating heater. Two stages of extraction heaters on the turbogenerator and on two of the turboblowers raise feed to a final temperature of about 300 F. Makeup to the 450 psi system is from a hot process lime and soda softener.

The power station is located within a few hundred feet of the lake, so it has an adequate circulating water supply. Gravity flow intake and discharge tunnels extend the length of the turbine room and vertical pumps are located adjacent to the units they serve. The mill service water pumps take from wells which can be supplied from either the intake or discharge tunnels.

Interconnections of Turboblower

Figure 4 shows the interconnections between a turboblower discharge and the blast-furnace mains. Each of the blast mains shown in section at the right of the drawing services one blast furnace. Each blower is connected to three mains so a high degree of flexibility is obtained. The blast mains are 48 and 54-in. diam.

The arrangement of the last extension to the power station was planned to allow for a further extension which will house one more 60,000 kw unit and a 650,000 lb per hr boiler. This will complete the eastward extension. No further extension is contemplated on the west end of the turbine room though there is space for additional boilers at that end.

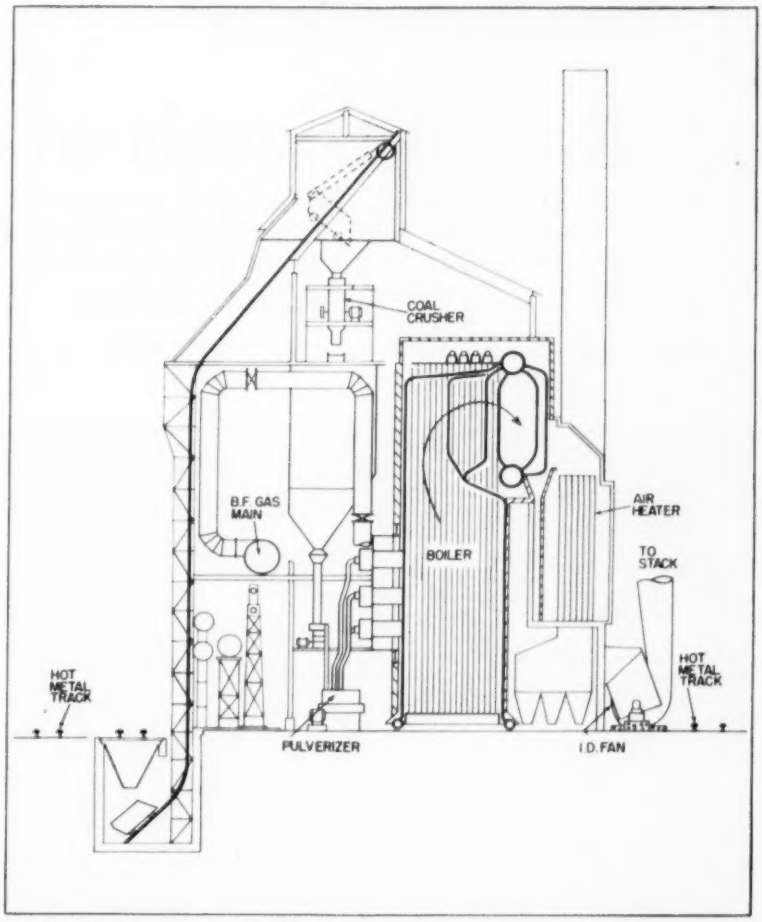


Fig. 7. Section through new building. Boilers burn either blast-furnace gas, coal, or coke oven gas. The blast-furnace gas is cleaned by electrostatic precipitators before it enters the boiler house. Coal, when it is used, is distributed from the crusher by belt conveyor to the individual bunkers for each boiler.

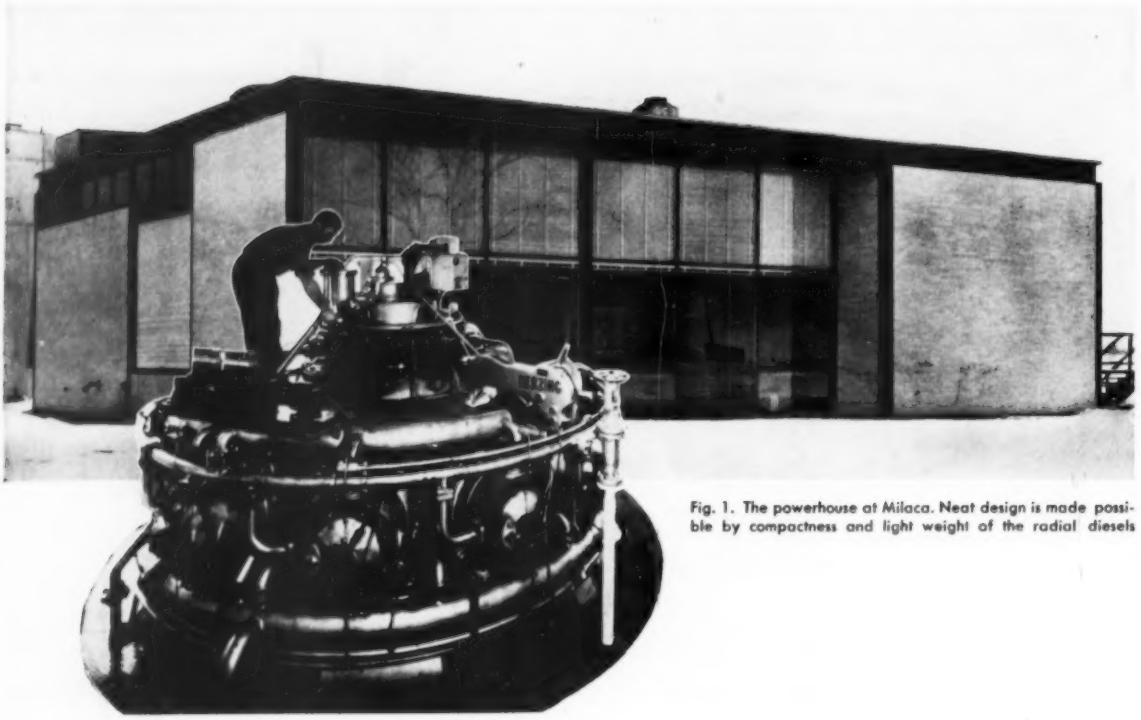


Fig. 1. The powerhouse at Milaca. Neat design is made possible by compactness and light weight of the radial diesels

Radial Diesels at Milaca

The two 1500 kw radial diesels in this municipal power plant are smaller, safer and easier to maintain than conventional engines, says the man who looks after them. Here are details, and the man is

DONALD L. COCHRANE

Plant Superintendent

MOST PEOPLE THINK radial engines are used only in aeroplanes, and that powerhouse diesels are all vertical in-line machines. Many visitors to our plant, engineers included, ask questions ranging from "What is it?" to "Where do you make the steam?" Many think they are some kind of turbine or an overgrown aircraft radial, and we have quite a job convincing them they are perfectly sound diesel engines driving electric generators just as efficiently as the machines they are accustomed to seeing, and having into the bargain several advantages over their more conventional looking brethren. Nearly all visitors, for example, compliment us on the neat outside appearance of the building as soon as they arrive, without realizing that the compact units inside, which they think so odd, are responsible for the small size and modern design of the outside. They are the same type of engine as installed by the dozen in the big Southern Aluminum plants described in the April issue. Here, however, we have only two of them. The plant is that of the Rural Co-operative Power Association, at Milaca, Minn., and in this article we will describe the main features and operation of our machines, and show how much easier it is to overhaul and maintain them than the common kind.

General Description

We have two Nordberg Radial Diesels here. They are 1685 hp each, 11 cylinder, 14 in. bore, 16 in. stroke, 400 rpm. They each drive an Elliott vertical generator rated 1612 kva. Full load for the engine is 1170 kw. These diesels are two stroke cycle with port intake and exhaust. The scavenging air is supplied by an external motor driven centrifugal blower. The motor is 150 hp, 3550 rpm, 2400 v, direct connected to the generator. This motor must start rolling when the engine does, and this is accomplished by getting pilot excitation for the generator from a battery set. This pilot excitation is controlled manually, and if the switch is not turned on, the engine will not start. After the engine is started and up to speed, excitation is switched back to normal. Crankcase vacuum is maintained by a 2 in. line from the crankcase to the suction side of the same blower. There is, of course, one blower for each engine. They have a common suction room in which the air from outside is pulled through an oil coated screen to remove all dust and other material. This screen travels through an oil bath for 8 seconds every 12 minutes to keep the screen well coated with oil and to wash off the dirt.

You will notice in the pictures that the engines take very little space, the two taking about as much room as one conventional engine of 1600 hp. The weight per hp is about 15 per cent less also. The absence of a massive concrete foundation makes the basement space much larger for the same outside dimensions.

There are two 24,000 gallon storage

tanks outside; vertical and above ground; with heat exchangers in them, which we do not use as we are burning No. 2 fuel. We are set up to unload either transport trucks or railroad tank cars with a pump in the basement. There is a transfer pump for each engine which takes the fuel from the outside tanks, pushes it through a small indoor heat exchanger, then through a large multi-cartridge filter to the day tank. The piping is arranged so any combination of pump, filter and heater can be used for either day tank. From the day tank the fuel is taken by a small pump, pushed through a final small filter and up to the fuel header on the engine. A pressure of approximately 30 psi is maintained here by a relief valve. From this header the fuel goes through a conventional American Bosch pump and nozzle to the combustion chamber. The pump and nozzle are mounted horizontally instead of vertically as is usual.

It should be noted here that we are now on standby duty with our large steam plant at Elk River, Minn., normally carrying the system load and furnishing our station power. With these conditions we must be able to start quickly from a dead plant if trouble develops on the line.

Starting

For this purpose we have three special pieces of equipment. A gasoline powered lube oil pump to furnish pressure during starting in place of the electric before-and-after pump; an overhead 25 gal fuel storage tank to furnish fuel header pressure in place of the electric booster, and a gasoline engine which we can belt to the air compressor in place of the electric motor if our starting air is low. The lube oil pump can be valved to either engine as can the fuel from the overhead tank. As soon as we can get one engine started we pick up station power and start the other one with the usual auxiliaries.

Lubrication System

The lube oil system for each engine consists of a sump tank, electric auxiliary lube pump for before and after use, a gear driven pump at the base of the generator shaft which furnishes pressure during operation, and a pair of heat exchangers for cooling the oil. A separate pump and piping system takes the oil from the sump tank, pushes it through an electric heater and a large cartridge filter, then back to this sump tank. The same pump is used for emptying or filling the sump tank or the dirty or clean oil storage tanks. We can take oil from the dirty oil tank and fill barrels upstairs on a truck. The oil is reclaimed at one of our other plants. The electric heaters mentioned above are used to warm the oil before a scheduled run or when bad weather is approaching. In unexpected emergencies we do not bother with heating the oil however as the main thing is to get on the line.

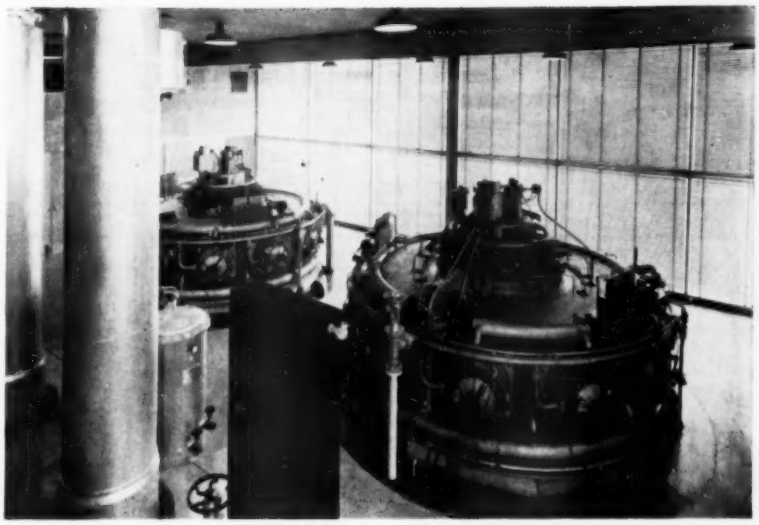


Fig. 2. Inside view of the powerhouse showing the two 1500 kw radial diesels driving vertical generators

Cooling System

The cooling systems are closed and joined. Each engine has a 450 gpm jacket water pump which pushes the water through the engine, radiator, lube oil cooler, and back. A side line takes some of the jacket water through the small fuel oil heaters to warm the oil a little. These are used only in winter. Each radiator is cooled by a large fan driven by a 50 hp, 220 v, 2 speed motor. A three way automatic valve maintains the water temperature leaving the engine at about 140 F, which keeps the oil leaving the engine at about 154 F. Any combination of pump and radiator may be used to cool either engine. When we have one engine running we usually warm up the water in the other one.

We have our plant heating boiler associated with the jacket water systems via a heat exchanger where the 15 psi steam heats the jacket water. A small pump for each engine pushes the jacket water through here and back to the engine or radiator as valved. We usually use this system to keep the radiators from freezing when we are not running in the winter.

In conjunction with the above system for radiator protection we have a structure on the outside with doors in the bottom. These are kept closed unless we are running. Inside the building above the radiators there are metal louvres which control cooling fan air outlet. In between the radiators and these louvres we have large canvas curtains which slide horizontally across the 8 ft wide room. These prevent room heat escape when we are not running. These accessories are all easily handled by one man.

The battery set previously men-

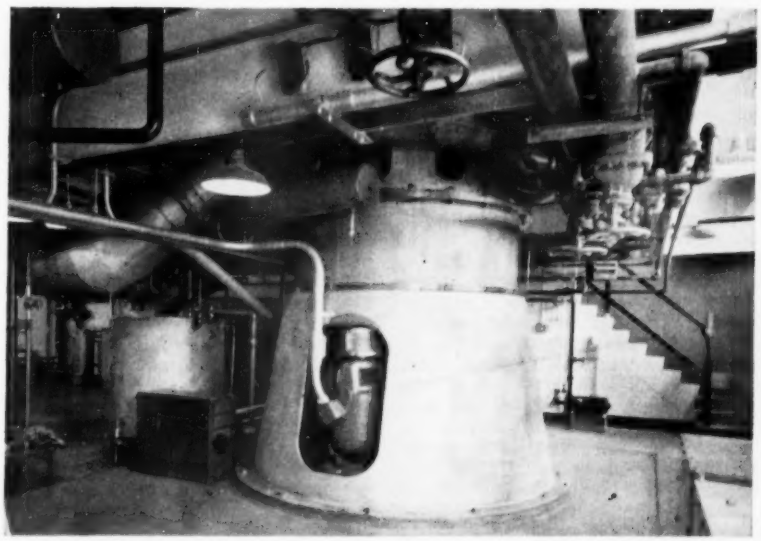


Fig. 3. A view of the powerhouse basement showing engine base and auxiliaries. Note light construction

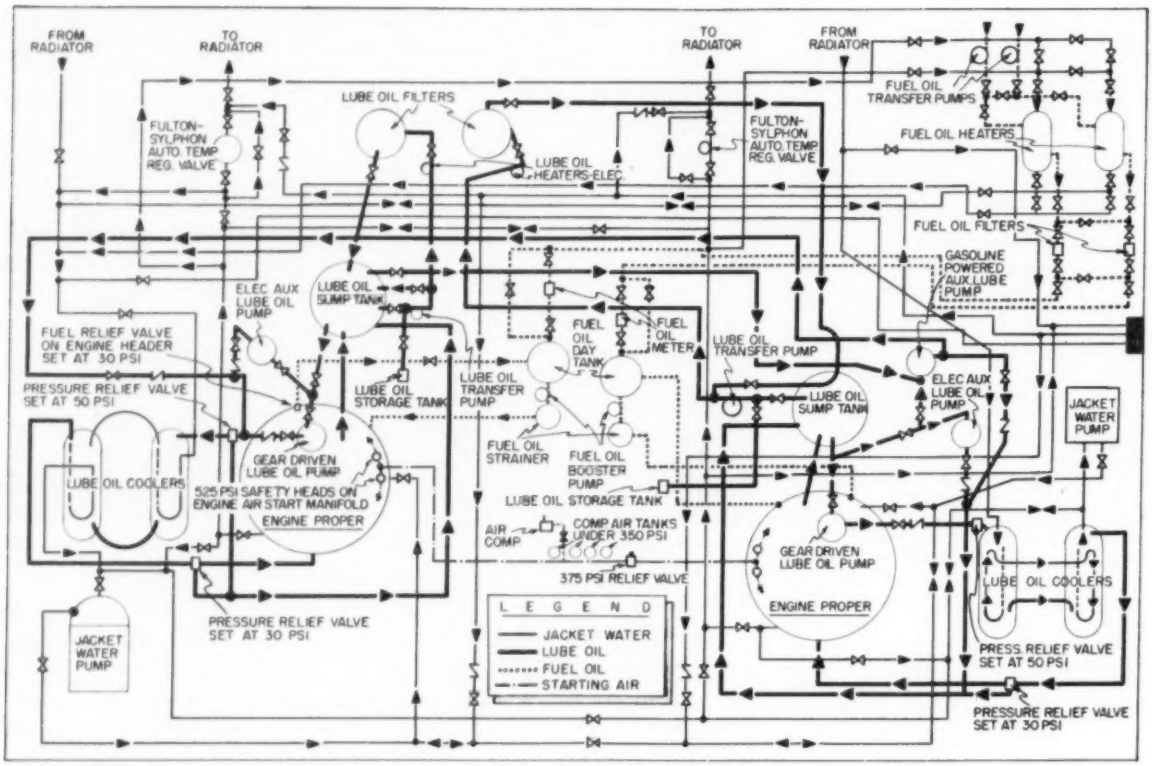

FROM RADIATOR
TO RADIATOR
TO RADIATOR
FROM RADIATOR
LUBE OIL FILTERS
FULTON-SYLPHON AUTO. TEMP REG. VALVE
LUBE OIL HEATERS-ELEC
FULTON-SYLPHON AUTO. TEMP REG. VALVE
FUEL OIL TRANSFER PUMPS
FUEL OIL HEATERS
FUEL OIL FILTERS
GASOLINE POWERED AUX. LUBE PUMP
ELEC AUX LUBE OIL PUMP
LUBE OIL SUMP TANK
FUEL OIL DAY TANK
FUEL OIL METER
LUBE OIL TRANSFER PUMP
FUEL RELIEF VALVE ON ENGINE HEADER SET AT 30 PSI
PRESSURE RELIEF VALVE SET AT 50 PSI
LUBE OIL STORAGE TANK
LUBE OIL TRANSFER PUMP
LUBE OIL SUMP TANK
ELEC AUX LUBE OIL PUMP
JACKET WATER PUMP
GEAR DRIVEN LUBE OIL PUMP
LUBE OIL COOLERS
525 PSI SAFETY HEADS ON ENGINE AIR START MANIFOLD
ENGINE PROPER
FUEL OIL STRAINER
FUEL OIL BOOSTER PUMP
LUBE OIL STORAGE TANK
AIR COMP
COMP AIR TANKS UNDER 350 PSI
375 PSI RELIEF VALVE
GEAR DRIVEN LUBE OIL PUMP
ENGINE PROPER
LUBE OIL COOLERS
PRESS. RELIEF VALVE SET AT 50 PSI
PRESSURE RELIEF VALVE SET AT 30 PSI
JACKET WATER PUMP
PRESSURE RELIEF VALVE SET AT 30 PSI
L E G E N D
JACKET WATER
LUBE OIL
FUEL OIL
STARTING AIR

Fig. 4. Diagram showing the circulation of the fuel oil, lubricating oil, jacket water and starting air for the two 1500 kw radial diesels at Milaca, Minnesota

tioned furnishes current for the d.c. controls of the switchboard and substation and also emergency lighting if the station power goes off at night.

Maintenance and Safety

Now to get to the maintenance aspects of the plant and engines, where they shine over their conventional brothers.

We have all the conventional tools and a few made up specially for these engines, the most important being our radial hoist, which has an operating radius of 14 ft from any point on a regular monorail which crosses the center of both engines.

We have several safety features over conventional plants, the most important one being that the engine platform is only 4 ft above the operating floor. The bolts for the topmost cover are the only heavy pulling jobs done from this platform. The main crankcase cover bolts are loosened by one man on the operating floor. When the three pieces that cover the crankcase are removed and rolled away on the special trucks made for them, the eleven connecting rods are available for loosening, in rotation, by barring the engine over. The cylinder head nuts can all be removed and installed by one man on the operating floor, as can the heads themselves. We take the weight of the heads on the radial hoist, slide them off the bolts, roll the hoist to the extremity of the beam and set the head down. If the head would be in the way at any point we can push the hoist around the engine to where the head will not be in the way.

The loosening of the connecting rod bolts is generally a two-man job as it saves a lot of getting up and down to have one man placing the wrench and another doing the pulling. The knuckle pins are pulled with a special tool provided for the purpose. Then one man in the crankcase with a hardwood 2 x 4 can push the rod and piston nearly all the way out. The man on the outside puts the canvas lifting sling on at the balance point, then the inside man pushes the assembly the rest of the way out by hand, holding the rod so it cannot hit the cylinder wall until the man on the outside has it under control. The two men then set the piston on its crown, remove the sling, pull the wrist pin covers and wrist pin. Then one man pulls the rod away and the other takes the 144 lb piston to the cleaning area.

Do that eleven or twelve times depending on the size of the engine — eleven on ours — and in 24 hrs more or less — depending on the number and quality of the crew — the engine is apart. The reassembly routine and time is about the same.

Cleaning Aluminum Pistons

The pistons in our engines are all aluminum and so must be handled with care. We use Bendix Cleaner for loosening the carbon. We have plastic coated canvas gloves to protect our hands when washing the pistons. The ring grooves and lands usually must be soaked in the cleaner for a couple of hours but the rest of the piston can be washed clean without soaking. After cleaning with Bendix all parts are neutralized by rinsing in a part cleaning solvent.

Removing Carbon

The carbon still in the grooves is generally quite soft after the soaking and we remove it with a piece of composition belting the thickness of the ring groove. We dip this in the Bendix and run it around the grooves several times. This removes all but the stubborn which may have to be scraped with a small screw driver or other tool. Care must be taken not to scrape any of the aluminum off. Working as just described, several pistons can be in the various stages of cleaning at the same time.

After an overhaul the cleaner is allowed to set for a while for the carbon to settle out, after which it is poured off and stored for future use.

A word of caution to anyone who may want to use this cleaner. Keep it off the skin and be particularly careful about splashing in the eyes. Also the room should be well ventilated, as fumes are strong.

The generators are vertical machines, mounted below the engines, and the rest of the electrical system is standard, being unaffected by the unusual prime movers These engines operate much the same way as the more conventional types, and they behave well on both steady and fluctuating loads.

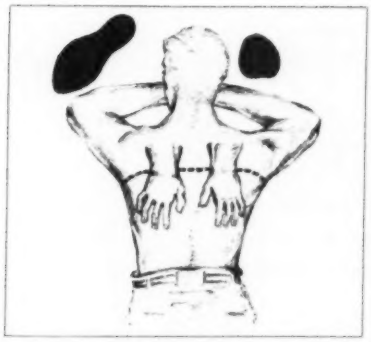


Fig. 1. Position of the subject: Place the victim face down as shown. Loosen clothing at neck and waist and clear mouth and throat of any obstruction. Be sure he has not swallowed his tongue. If a drowning case, incline his body slightly so that liquid will drain away from the respiratory system. Bend his elbows and place his hands one upon the other. Turn his face to one side, placing his cheek on his hands. The black marks at top of diagram show positions of your knee and foot.

Fig. 2. Position of the operator: Kneel on either your right or left knee at the head of the victim and facing him. Place your knee at the side of his head close to the forearm. Put your opposite foot near his elbow as shown above. If it is more comfortable, kneel on both knees, one on each side of his head. Place your hands on the flat of his back so that the heels of the hands lie just below a line running between the armpits. With the tips of thumbs just touching, spread fingers downward and outward.

Fig. 3. Compression phase: Rock forward until your arms are nearly vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward on your hands. This forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downwards.

Fig. 4. Position for expansion phase: Release the pressure, avoiding a final thrust, and commence to rock slowly backward. Then place your hands upon his arms just above the elbows.

Fig. 5. Expansion phase: Draw his arms forward and toward you. Apply just enough lift to feel resistance and tension at his shoulders. Then lower his arms to the ground. This completes the full cycle. The arm lift expands the chest by pulling on the chest muscles, arching the back, and relieving the weight on the chest. The cycle should be repeated 12 times per minute at a uniform rate. The compression and expansion phases should occupy about equal times, the release periods being as short as possible.

Artificial Respiration—
New Improved Methods

Three methods on this and following pages give latest practice. The Holger-Nielsen, shown here, will probably become the most widely used, but for some accidents the Schaefer is still preferred. The pole top method is for men electrically shocked aloft. Industrial power engineers as well as utility men should know all three

The Holger-Nielsen Method

AN IMPROVED METHOD of artificial respiration for victims of electric shock, drowning, suffocation, or gas poisoning has been approved by the American Medical Association and the American National Red Cross. It is known as the back pressure — arm lift, or Holger-Nielsen method. It is a modification of the Nielsen method, named after its inventor, the Danish swimming coach Holger Nielsen, which has been in successful use in Scandinavian countries for twenty years.

Recent tests show that this method delivers twice as much air into the lungs as the Schaefer, or prone pressure method, and though the Schaefer is still the most widely used method of resuscitation in the country, the Holger-Nielsen will probably supersede it eventually as the standard. However, even if the Schaefer is relegated to second place, it will still be the best one to use where injuries to the back, shoulders or arms prevent the Holger-Nielsen being used, and for this reason both methods should be learned and practiced.

The following important rules, which apply to every form of resuscitation, apply also to the Holger-Nielsen method. Start resuscitation immediately; time is vital, and a few seconds delay can make all the difference between success and failure; send for a doctor at once; and when you start resuscitation, do not stop until instructed by a doctor, or until four to six hours have elapsed, or until rigor mortis sets in.

For a tear sheet of the methods of resuscitation described here, write to the Editor, POWER ENGINEERING.

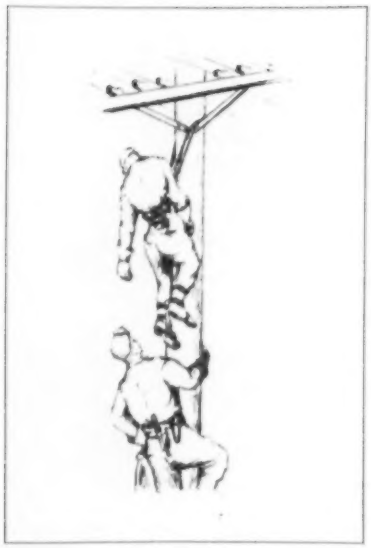


Fig. 1. When you see that a man up a pole has received an electric shock, call out to the other men telling them about it. Observe pole conditions and plan your action quickly and carefully. Put on rubber gloves and sleeves before going up the pole if it is possible to do so immediately, but do not waste time if you cannot do it at once. Climb pole as quickly and easily as possible to conserve your strength. Remove victim from wires cautiously, taking care you don't get hurt yourself, and let him hang from the pole by his safety strap. Remove tools or equipment from his belt which might injure either of you.

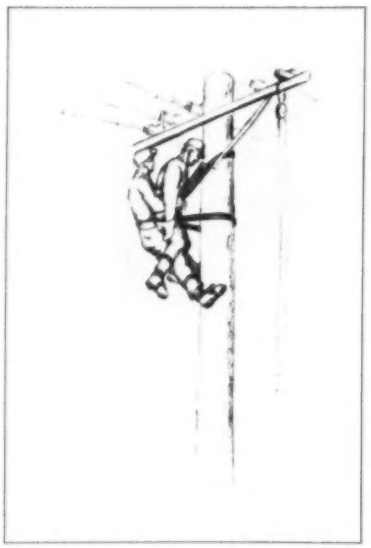


Fig. 2. Make sure his belt is secured so that it will not slip on the pole, and remove his spurs so that his legs hang down loosely. Get in position behind and below him and put your safety strap around the pole. Then work your way up the pole with one of his legs on each side of your safety strap, until the strap is as high as possible between his legs. Now take a step up and place him in position for resuscitation as described in Fig. 3. His safety strap should remain around the pole and you can use it to keep him in the right position while you work on him. Do not remove it until ready to lower him.

Fig. 3. Now put your arms around the victim's waist and place both hands on his abdomen, thumbs just below the lower ribs and fingers touching. Cup your hands so they will not slip. Compress his abdomen in an upward motion. Release pressure quickly and reapply at a frequency of 12 times per minute until he regains consciousness. Do not apply too much pressure. The object of the technique is to raise the abdominal organs against the diaphragm uniformly across the body. Diagram shows the first position of hands, relaxed, before the inward, upward motion to raise the abdominal organs.

Pole Top Resuscitation

Many men have died aloft unnecessarily because resuscitation was not started until they had been lowered to the ground. The pole top technique, which enables artificial respiration to be started immediately, is an emergency measure to supplement the other methods shown here. It has already saved many lives

THE FIRST RULE of resuscitation is to start work immediately, and every second you delay is dangerous. When a man is electrocuted aloft, either on a pole, a substation structure, or in a plant with overhead distribution in a building, the time taken to lower him to the ground before starting artificial respiration may mean the difference between life and death for him. The pole top technique enables resuscitation to be started immediately. Even if its efficiency, in terms of the amount of air drawn into the lungs at each stroke, is less than other methods, it is better to have a less efficient method started right away than use the best method in the world when the man is dead.

This method also gives men time to prepare equipment for lowering the victim to the ground. It is no easy task to lower an unconscious man from a height; the rigging required is seldom there when it is needed, and many lives have been lost while tackle was being prepared and a man lowered. Many of these lives would have been saved if resuscitation had been started at once while the man was still up the pole.

The pole top technique is an emergency measure to supplement the prone pressure methods. It was developed by the Duquesne Light Company, and was presented to the electric light and power industry in 1938 by E. W. Oesterreich, General Superintendent of Distribution of that company. It is sometimes known as the Oesterreich method.

Schaefer Prone Pressure Method

When a patient's back, arms, or shoulders are injured, the Holger-Nielsen may be unsuitable, and the Schaefer should be used. This method, which has been standard in the electrical industry for many years, was developed in 1903 by Sir E. Sharpey Schaefer of the University of Edinburgh, and was introduced into the United States in 1907. Though most readers will know it well, it is shown here so it can be compared with the new Holger-Nielsen method

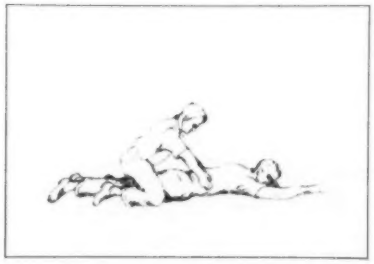


Fig. 1. Hands in position: — Lay the patient on his belly, one arm extended directly overhead, the other bent at elbow and with his face turned outward and resting on hand and forearm so that nose and mouth are free for breathing. Kneel straddling his thighs and place your hands on the small of his back with fingers resting on the ribs, the little fingers just touching the lower ribs. Make sure there is nothing in his mouth.

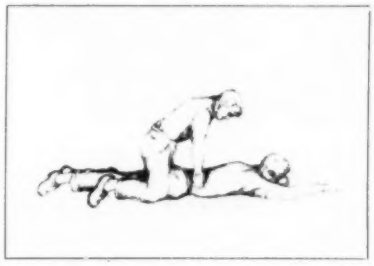


Fig. 2. Pressure on: — With thumb and fingers in a natural position, the tips of the fingers just out of sight, and with arms held straight, swing forward slowly so that the weight of your body is gradually brought to bear on the patient. The shoulders should be directly over the heels of the hands at the end of the forward swing, as shown in the diagram. Do not bend your elbows. The operation should take about two seconds only.

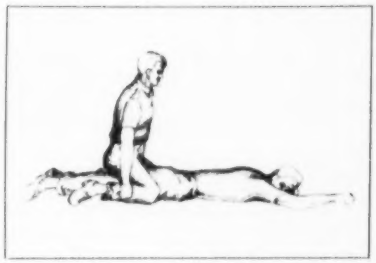


Fig. 3. Pressure off: — Once your full weight is upon the patient's back, with your arms vertical, as described in the preceding illustration, immediately swing backward so that the pressure is completely removed. After two seconds swing forward again the same way. Thus repeat deliberately twelve to fourteen times a minute the double movement of compression and release to make a complete respiration every four or five seconds.

Text and illustrations of the above methods are adapted from the publications of Edison Electric Institute, National Safety Council, Consolidated Edison Co. of New York and Dr. W. Schweisheimer. For copies of these and further information, write The Editor, POWER ENGINEERING. For convenience, use the return postal card elsewhere in this issue.

Integrity and Professionalism for Young Engineers

GREATER DEVELOPMENT of integrity and professional competence, especially in the young engineer, was urged by speakers at an education session of the annual meeting of the ASME.

Clement J. Freund, dean of the College of Engineering, University of Detroit, after pointing out that the professional man commands confidence by his reputation for technical competence and for integrity, said:

"We engineers have given precious little effective thought to integrity. It is true that scholars and statisticians have investigated us over and over, and each time 90 or more per cent of us have insisted that character — and by that we mean integrity — is the most important qualification of the engineer.

"On the other hand, though, examine the content of the mechanical engineering curriculum from the freshman to the senior year; check through all the problems and exercises which the student has to turn in; look over all the extra-curricular activities. You will find that 95 per cent of the whole is designed to develop the student's technical competence, and less than 5 per cent, if any at all, serves to strengthen his integrity."

Mr. Freund admitted the concern of engineers about their professional responsibility and integrity but pointed out that "mere concern gets nothing done."

"Should we not require our students to study ethics in the colleges and schools of engineering?" he asked. "Should we not find a place for ethics in the post-graduation training and experience courses in our industries? Or if we insist that ethics should be learned in home, school and church, should we not test applicants for admission to the colleges to be sure that they have learned their lesson?"

R. E. Burton, manager of the Control Division, Engineering Department, E. I. duPont de Nemours & Company, discussed the development of professional competence in young engineers.

Among the several "specific aspects of the young engineer's work that will reveal the degree of professional capability he has attained," Mr. Burton cited the following: the engineer's respect for his own time; his economy of the employer's time and materials; his relationship with fellow engineers, craftsmen and auxiliary groups; quality of work; diligence in keeping abreast of advances in the profession; and his concern for the satisfaction and safety of the public in using his machines, devices or structures.

He stated, however, that professional competence can be developed in young engineers "only in proportion to the degree of professionalism exhibited by their superior."

Rehabilitating Open Feedwater Heaters

In our June issue the author described how to eliminate closed feedwater heater troubles and improve design. Here he does the same for open feedwater heaters

By C. W. BELL, Sr.

Engineering Consultant

MANY OPEN HEATERS still in use were designed before the days of feedwater deaeration. Some are so old the original makers no longer furnish parts except on "pattern plus part" prices. In some cases the original makers are no longer available.

Our discussion will apply to situations where the main heater shell is still in safe operating condition, if cast iron. (Steel shells can always be renewed in place.)

Racks and trays originally constructed of cast iron can be replaced with steel — preferably stainless, or some other sheet metal. Lightweight replacements require close fitting and fastening so they will not be lifted out of place by surges of boil back, or flash due to sudden pressure reductions.

Trays when home-made do not need to be exact replicas of the originals. The usual requirement is that the water be broken up into small streams so that it falls as rain from tray to tray, particularly in the major drop into the storage space.

A heater may be in very good condition physically but produce poor results due to trays or cascading elements being off level or otherwise accidentally disarranged. (This can happen to new modern units also.)

In common with closed heaters, and even more so, the behavior of any of the heavy noncondensables can be quite accurately predicted. Obviously they will tend to collect at water level — usually at the point farthest from the steam inlet, this depending on arrangement of tray structure and baffles.

The liberally sized open vent in the top of a simple box type heater obviously has little effect on these gases except when they accumulate to a level where some may be carried away with the outgoing steam.

Such heaters can usually be deaerated by the simple addition of air "pick-ups" constructed close to water level — 1 in. above overflow.

A quite satisfactory device here is a piece of $1\frac{1}{2}$ in. to 4 in. schedule 40 pipe (thinner stainless tubing is better if available) closed at the ends and with perforations in its bottom quadrant. The maximum operating level should be as close to the overflow or "spill" level as possible. In some cases this may be as little as 2 in. while other situations may require 4 in. or even more. It must be determined by observation during operation. Actual spillage via the overflow should be very infrequent.

The minimum operating level is controlled by a combination of many factors, some of which are: relation of steady state heating capacity to momentary peak loads; maintaining a satisfactory quantity of hot water in reserve; hydrostatic head at boiler feed pumps; operating stability.

The air take-off at V^1 (Fig. 1) must be just slightly higher than the overflow so that it will never become flooded except under extreme conditions (transient).

For vent condenser operation the size of piping, number of connections through the heater wall, and total area of perforations must be proportioned for the desired flow. If possible, the pressure drop vs hydrostatic head should be nearly in balance so that condensed drip will flow back into the water distribution system of the heater.

If a large vent condenser is used it may be necessary to take part of steam from the heater top — original vent stack. In some cases it may prove expedient to return the drip to a hot well. It should not go into the heater storage space without deaerating.

For direct atmospheric venting the smaller size pickup device will be ample and it should have two or three perforations of say $\frac{1}{2}$ in. effective diameter. Further throttling may be needed — if so, it can be

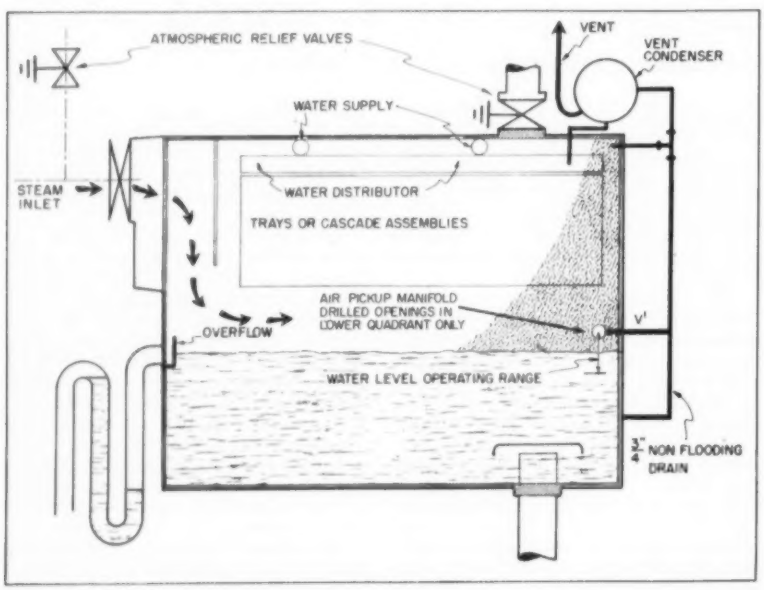


Fig. 1. Section through a box type open heater with a vent condenser added. The shaded area indicates natural concentration of non-condensables; V^1 is low level vent for removal of O_2, CO_2, and other gases

done by an external orifice plate. This is shown in Fig. 3.

These free vents should always be accessible for checking steam discharge — not combined with other vents. Just enough steam should be wasted to assure holding non-condensables to a satisfactory maximum, this to be measured by oxygen content which should be not over 0.010 cc per liter — suggesting that in some cases at least the results will not meet the specifications of 0.005 cc or better required of new equipment. Fortunately CO_2 is removed along with oxygen. This tends to raise the pH of the feedwater, though it is usually necessary to feed chemicals to obtain the desired 8.0 to 8.5 at the boiler feed pumps.

When choking off the conventional main vent on open heaters provision must be made to protect against pressure build-up due to hot returns from higher pressure sources connected directly into the heater body.

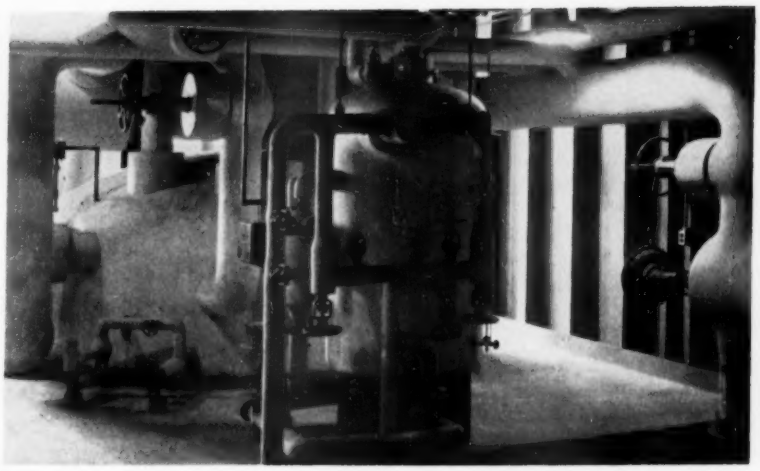


Fig. 2. Shows a good example of a modern deaerating heater at one of the new Eastern power stations

Relief Valves

As long as the gate valve on the main steam input line is open, the relief valve customarily located just outside is adequate. If, however, that gate valve is closed and any one of the hot drip or live steam connections discharge into the heater, a dangerous pressure may develop. This may not happen often and in some situations it may be sufficient to make sure the overflow connection is arranged so that no harm will be done by "blowing" the seal instead of a relief valve. Since this always requires recharging a seal it is not a very desirable operating arrangement. A relief valve on the original vent as indicated in Fig. 1 is desirable always, and is necessary if large quantities of flash or live steam are possible.

Contamination During Shutdowns

Considerable damage has been done to boilers, feed pumps, the piping system, etc., where plant operation is intermittent, particularly on nightly shutdowns. If a body of feedwater is allowed to stand exposed to air it will absorb oxygen, CO_2, etc., and at each cold start this poisoned water is pumped through to the boilers.

In the feed pumps it takes very short runs — a matter of minutes — to destroy protective films, and relatively rapid corrosion-erosion is likely to occur. Pit type corrosion will develop in the boilers.

Two possibilities, at least, should be considered:

(a) If an emergency steam source is available, keep the water blanketed with steam. This steam should be controlled by a very sensitive and reliable automatic valve.

The limitation of this method will be the boiling of water in the incoming lines, particularly where the water approaches from the top as through a top mounted vent condenser. There it is possible to do physical damage as serious "water hammer" will occur in some situations. Tube packing rings will deteriorate rapidly.

(b) Install a recirculating connection for heating and deaerating all the water in the heater and piping to the boiler feed pumps and beyond them to some nearby main shut off valve or valves. The other end of this recirculating connection should enter the water supply line at the inlet end of the vent condenser.

This recirculation can best be accomplished with a small low head pump large enough to move the whole body of water in about five minutes, time here being entirely optional. A second choice would be variable speed boiler feed pump operated at low speed. It can be handled, if necessary, with a boiler feed pump operated at full speed. When this method is used the flow must be throttled to control pump motor load.

Recirculation should precede every occasion when water is added to a boiler as during a week end or night shutdown and should be continued with normal steam pressure in the heater until the water in the feed pump suction line reaches full boiling temperature. Where a pH recorder is used, the pH should be brought up to normal. Water may then be pumped to boilers.

Oxygen in Boilers

After a heater has been modified to give reasonable deaeration, sufficient sodium sulphite needs to be fed into the water stream to maintain a slight excess in the boiler water — the oxygen residue is absorbed in converting the Na_2SO_3 to Na_2SO_4 which becomes a part of the over-all chemical treatment.

Most very old installations were laid out with little if any consideration given to flashing at the pumps. The heaters simply used up what incidental exhaust steam happened to be available which in many situations produced water temperatures from 150 to 190 F.

Many such heaters were moved to higher elevations making it possible to increase the water temperature to the boiling point and still get satisfactory acceptance at the pumps.

Complications such as inadequate pressure on the water supply line to the heaters or exceedingly cramped space have prevented many heaters being moved. For cases like this various methods have been adopted to permit oiling the water to deaerate it and still get stable operation of the boiler feed pumps.

The following are examples of these methods:

1 — Install a heat exchanger on the hot water line leaving the heater to reduce the water temperature say 15 or 20 F. The condition to strive for is a temperature to give 10 deg. margin below the critical flash point. Two pump loads must be considered:

(*Continued on page 100*)

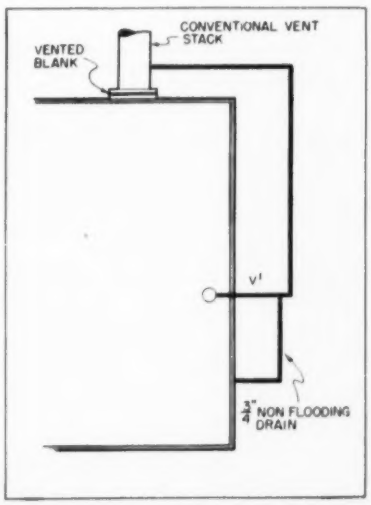
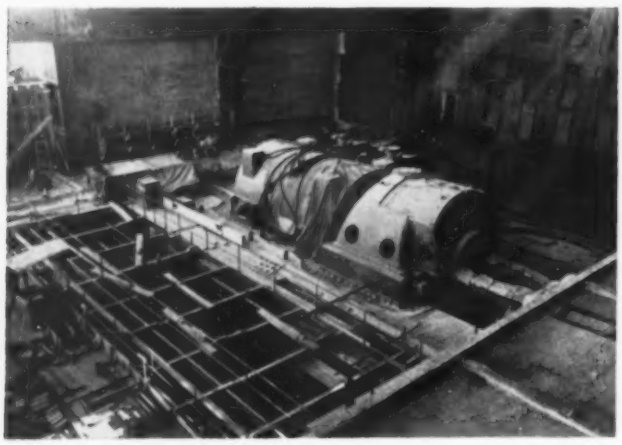


Fig. 3. Connections for venting direct to atmosphere using overflow as pressure relief device

Power Engineering NEWS REEL

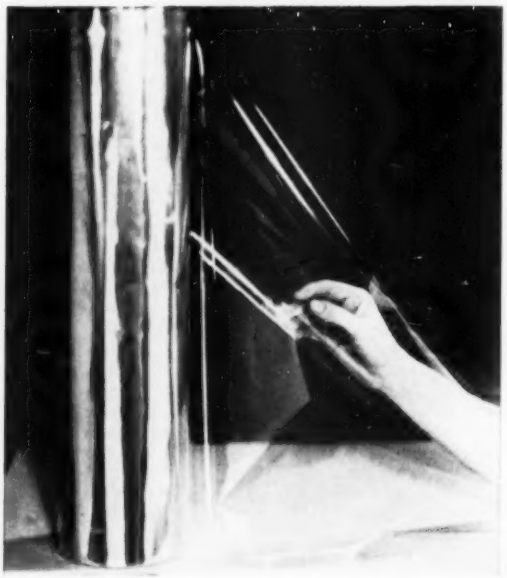
U-shaped Calrod tubular heaters, each 120 ft long, are loaded on a special 65-ft gondola car for shipment to the Albeni Falls Dam near Newport, Washington. The heaters will enable the dam gates to be operated during sub-freezing conditions

Israel's farm, home and industrial modernization will accelerate when the new Tel Aviv power station goes into operation. Here one of two American 50,000 kw generators, purchased here with Israel Bond funds, is being erected at Tel Aviv

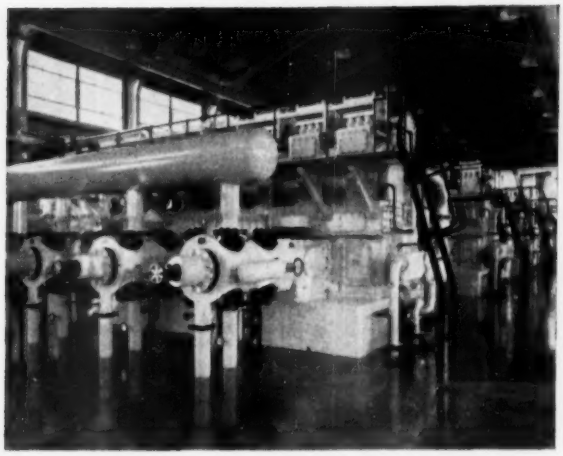


One of three turbine-generator stators ordered for the Bokaro plant of India's Damodar Valley Project is unloaded at Calcutta Harbor. Made at General Electric's Schenectady plant, the units will contribute to India's industrial and agricultural progress. (For the Bokaro Plant story, refer to POWER ENGINEERING October 1951)

High tensile and impact strength together with the ability to be metalized under vacuum should give du Pont's new Mylar polyster film an important role in small electrical apparatus of the future. The film will be available in sheet or tape as thin as 0.00025 in.

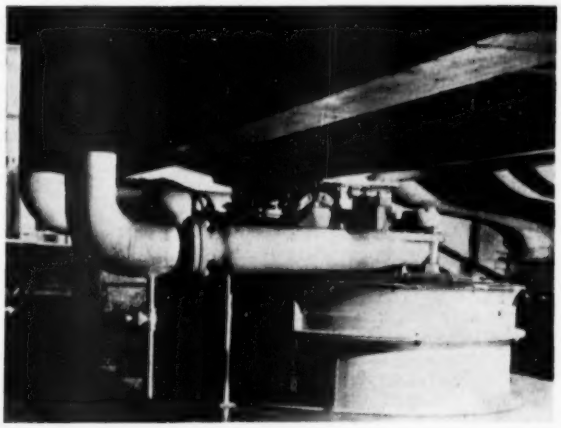


Once thin wires, these zirconium crystal bars were formed by a new deposition process developed at the Westinghouse Atomic Power Division plant. The new process opens the door to mass production of zirconium, recently demanded for the construction of a submarine nuclear reactor of a new type



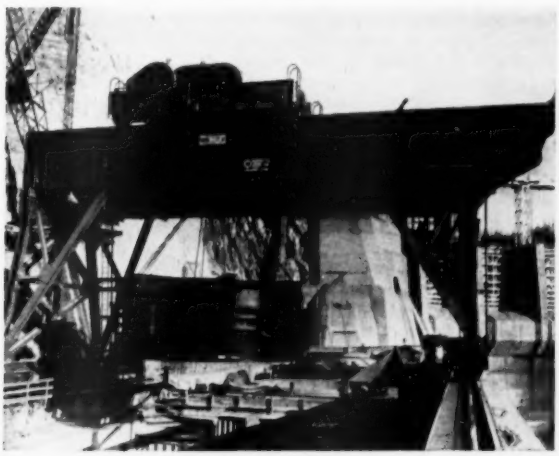
The McComb, Miss., compressor station is the first of eight scheduled for service in the United Gas $250,000,000 expansion program. Five Worthington engine-compressors (1600 hp at 320 rpm) move gas from wells in Louisiana and beneath the Gulf of Mexico through a new 30-in. pipeline to Jacksboro and Kosciusko, Miss. The system will handle 4 billion cu ft per day when its eight stations and 1,735 miles of the pipeline are finished in 1953

Low clearance is no problem for this Wing turbine-blower combination in E. R. Squibb's New Brunswick plant. The 47,700 cfm unit (5 in. static pressure, 1850 rpm) occupies a space only 54 in. in diameter by 33 in. high under the rear boiler overhang. It provides forced draft for the Babcock & Wilcox boiler



This steel shell, when completed will house an atomic power plant currently being developed for submarine use. The structure is being erected at West Milton, New York, by scientists of the Knolls Atomic Power Laboratory, which is operated by General Electric Company for the Atomic Energy Commission. Access into the completed sphere will be through air-tight entrance locks

The third of four large generators is lowered into the new Cabinet Gorge Hydro-Electric Station near Clark Fork, Idaho. The 275-ton gantry crane, designed for safe operation at 330 tons, will remain after completion of the project to expedite servicing. The fourth generator will be in service in July, 1953, bringing the generating capacity of the plant to 200,000 kw



New 4500-psi Generating Unit Breaks Through Critical Steam Pressure Barrier

Plans for new 120,000-kw turbine generator for Philo Plant include once-through boiler to generate steam at 4500 psi for turbine. Initial steam temperature goes up another notch to 1150 F. This will be the first U. S. commercial unit to cross critical pressure barrier

MAJOR FORWARD STEP in the technology of economical steam-electric power generation will be a new boiler and turbine generating unit designed to cross the barrier of "super-critical pressure" of steam for the first time in the commercial production of electric power. It is expected to be the most efficient generating unit ever built and will utilize the unprecedented steam pressure and temperature of 4500 psi and 1150 F.

Announcement of plans to build the unit was made by Philip Sporn, president of American Gas and Electric Co., Alfred Iddles, president of The Babcock & Wilcox Co., and Glenn B. Warren, vice president of General Electric Co. and general manager of its turbine division.

After many months of study and preliminary design, the three companies have just reached agreements under which General Electric will design and manufacture a 120,000-kw turbine and Babcock & Wilcox will design and build the boiler for it. The turbine, at 4500 psi, will operate at almost double the present highest steam pressure utilized for power generation. The initial steam temperature of 1150 F will be 50 deg above the present highest and will be followed by two stages of reheat, the first at 1050 and the second at 1000 F. The boiler will be the "once-through" universal pressure type, in which water at 5500 psi is pumped through and changed into superheated steam in a single fast passage through the tubes in the boiler. It will be equipped with cyclone furnaces designed to insure rapid and complete burning of coal and minimize air pollution.

Three Companies Co-operate

Entire project, cost of which will exceed $12,000,000, is being engineered by American Gas and Electric Service Corp., a subsidiary of American Gas and Electric Co. The new unit will be installed under Service Corp. supervision at The Ohio Power Co.'s Philo Plant near Zanesville, Ohio. Ohio Power is an AGE operating company subsidiary.

In commenting on the project on behalf of the three companies associated in it, Mr. Sporn pointed out it was the consummation of more than 30 years of continuous work and development on the AGE System to bring about more economical methods of power generation and that the three companies have cooperated during the past three decades on a large number of other projects looking toward the same objective.

"Many new ideas in turbine, boiler and plant design will be incorporated and tested in this development," Mr. Sporn stated. Among these are the use of: (1) steam pressure above the supercritical pressure of 3206 psi.; (2) initial steam temperature of 1150 F., and (3) more than one stage of re-heat.

First Practical Design

"While the use of boilers above the super-critical pressure of 3206 psi had been considered before and while laboratory pressures above that value had been utilized," Mr. Sporn said, "no practical design had ever been developed." He explained that, above the super-critical pressure range, water passes immediately into steam, without any intermediate stage of "bubbling," such as is observed in a pot of boiling water at atmospheric pressure or exists in a boiler operating at any pressure below 3206. The use of this universal pressure boiler means that the boiler drum, biggest and heaviest single item of equipment in a power plant, used to separate the bubbles of steam from the water, and the re-circulating pumps are not required.

"It is this that in part makes the 'once-through' idea so attractive," Mr. Sporn said. "The boiler becomes, in effect, a continuous run of tube into which water is pumped at one end and out of which highly superheated steam is delivered at the other end." In such a boiler, the feedwater is not delivered to a central drum. Instead, it passes directly from a newly-designed feed pump through the boiler unit and is heated and converted to superheated steam at 1150, passing through the boiler and superheater just once.

The principle of "re-heat" of steam is used in the most modern power plants to practically utilize every ounce of energy contained in it. In the new Philo generating unit, the "double re-heat" method will realize even greater efficiencies. It involves leading the steam back into the boiler setting twice for reheating during its passage through the turbine.

"Use of higher pressures, higher temperatures and new ideas in reheat at Philo," Mr. Sporn declared, "will make possible not only new world standards of efficiency in generation of steam-electric power, but ultimately will make possible capital reductions by compressing size of units and bringing about more effective utilization of materials. In this work there will be available the background of experience of the last 30 years along with similar efforts integrated by the three organizations — AGE, G-E and B&W.

"Even more important," he continued, "is the fact that the successful development of power generation at this new plateau of higher pressures and temperatures will make possible, in time, still higher pressures and temperatures and additional reheats and resulting efficiencies hardly visualized a few years ago. Efficiencies of conversion of the heat in fuel into electric energy of the order of 50 per cent are distinct possibilities. Certainly they loom on the horizon."

Mr. Sporn recalled that this original unit was the first 600 psi steam-electric turbine operating on the reheat cycle to be installed in the United States. "In its day, this installation constituted a very significant advance in the economics of power generation, the full development of which has led to the high standards of capital and thermal efficiencies that are possible today, three decades later, in modern power plants operating below the super-critical pressures. We are equally sanguine about the advances that will follow from this new development in super-critical pressures, higher temperatures and multiple re-heat." (The first installation at Philo was described in *Power Plant Engineering*, June 1, 1925, later units in September, 1929, coal handling in August, 1946.)

New Turbine Design

The new Philo Plant unit will be a developmental model and relatively small as modern generating units go. However, to cross the barrier of critical pressures, new concepts of turbine design will be required for this machine. Its 120,000-kw capacity will increase net generating capacity of Philo Plant — one of Ohio's largest — to 495,000 kw. It will replace and use the same building now occupied by a 40,000-kw unit built in 1923.

Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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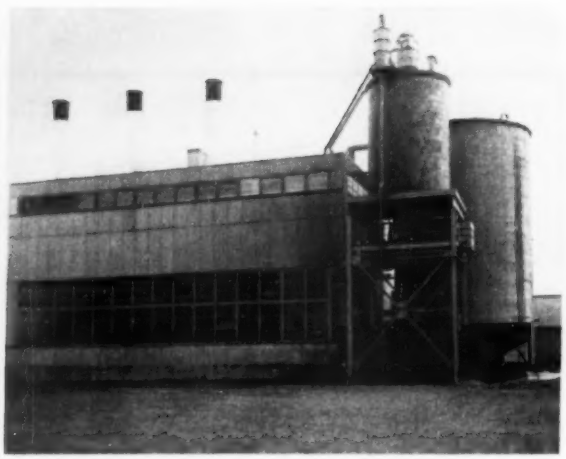

Fig. 1. (above) View of power plant showing 700 ton coal silo in background

Fig. 2. (left) Showing three coal-fired boilers with screw conveyor fed hoppers

By

F. R. MALMGREN

Building Superintendent, A. B. Dick Co.

Treated Coal Solves Silo Problems for A. B. Dick Co.

Frozen coal in rail cars, spontaneous combustion and hanging up in the coal silo were some of this plant's handling problems. They solved them with treated coal and unusual silo operation

IN 1949, A. B. DICK COMPANY, manufacturers of duplicating products, constructed a new plant at Niles, Illinois. The power plant for serving this factory was described in detail in the September 1950 issue of POWER ENGINEERING, and an outline of the coal handling system is given here to explain the problems which arose and show how they were solved. In brief, during our first two winters the power plant was in operation, burning coal, we had trouble with coal freezing in cars and silo, and with spontaneous combustion in the silo. These troubles were cured by purchasing properly treated coal, and altering our method of handling it in the silo. Here is what we had to work with and how we did it.

The power plant supplies the office and manufacturing plant with steam generated at 125 psi by three water tube boilers, each of 25,000 lbs per hr capacity. The boilers are designed to burn either coal or gas, and each is fired by a spreader stoker of the continuous ash discharge type, Fig. 2, or by two gas burners set in the rear furnace wall.

Coal Handling

Coal is delivered to the plant in hopper bottom cars, which dump it through a track hopper on to a bucket conveyor; thence it goes over a magnetic separator, and by bucket elevator up to the top of a 700 ton storage silo, into which it is dumped. The silo is shown in the rear of Fig. 1. From the live storage space above the sloping shelf in the silo, the coal discharges to a screw conveyor which carries it into the boiler room, where it is dumped into the stoker hoppers. A section of the silo in Fig. 3 shows the sloping shelf. High and low levels of coal in the hoppers are controlled by a level device that automatically stops and starts the screw conveyor.

We burn Southern Indiana coal, and it was in the cold weather that we ran into trouble. The coal has the following analysis: moisture 9.59, volatile combustible matter 34.80, fixed carbon 56.00, sulphur 0.66, ash 9.20, BTU 13,088. We used approximately 6000 tons of coal each winter; in the fall 1000 tons are placed in a stock pile as a safeguard against non-deliveries, and 5000 tons are scheduled into the plant at a rate of 4 to 6 cars per week, depending upon weather.

Coal Handling Troubles

There were three main troubles:

a. The coal froze in the cars
b. Coal froze in the silo and stuck to the walls in layers as thick as 18 in.
c. Spontaneous combustion of the coal occured in the silo; when this happened all coal had to be emptied from the silo to extinguish the fire.

Considerable attention was given to

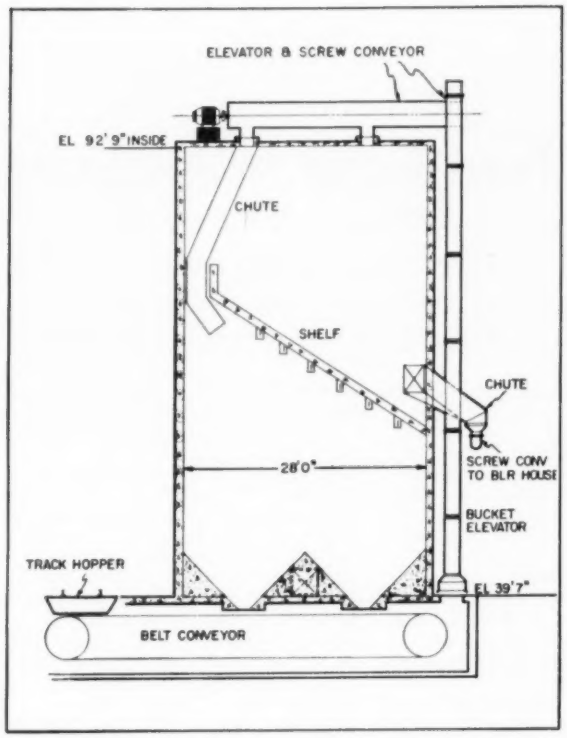

Fig. 3. Sectional elevation of coal storage silo showing sloping shelf inside

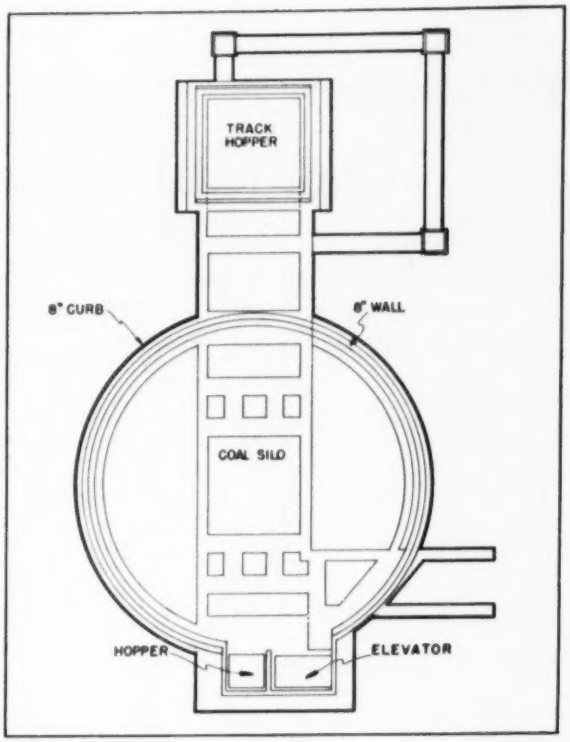

Fig. 4. Plan of the coal silo showing position of track hopper and elevator

these problems. Each of them entailed undue expense and meant working under severe hardships. Coal cars always froze in the worst kind of weather and the fires in the silo always took place on cold stormy nights.

The problem was attacked in several ways as follows:

High sulphur content is one of the prime causes of spontaneous combustion, so we are now purchasing coal with less than one per cent sulphur.

The coal is purchased from a supplier who has a mine on the same railroad as our plant. This means we get the coal in three or four days and the coal is not lying around at transfer points on railroads or getting water soaked and frozen. All cars are bottom dump type and we specify that the cars from this railroad only be used for coal transportation.

The coal is washed, dried, and oil treated. Washing and drying cleans the coal and eliminates surface moisture which is subject to freezing. The mine from which we purchase our coal has efficient equipment for preparing it to our specifications; therefore, washing and drying add nothing to the cost. Oiling prevents the coal from absorbing moisture from rain or snow in transit, and it also keeps the coal from oxidizing in the silo, which tends to retard spontaneous combustion. Oiling costs us 15 cts per ton, which is proving well worth while.

Coal Silo Rearrangement

Originally we used the bottom half of the silo for storage and worked off the shelf as much as possible so that coal remained in the bottom part of the silo for a long time without being moved, while the coal above the shelf was being moved continuously. Now we place all the coal in the storage section and when we want to use it, we draw it off the bottom and then place it on the shelf, from which it goes straight to the boilers. This keeps the coal in circulation and it does not remain in the silo for any length of time. We schedule coal deliveries so that all coal is used up by the time we are ready to burn gas, leaving the silo empty all summer, the stock pile being used last.

The combination of all these measures has eliminated our coal handling troubles. We had no trouble last winter; the coal did not freeze in the cars or the silo, nor did it hang up in the silo, and there was no spontaneous combustion. The past winter has been quite mild, and it was probably not a very good test period, but before making these improvements in our handling system we used to have trouble in weather that was no colder than last year. So we have high hopes for continued success in the future.

State Line To Have Controlled Circulation Boiler

ADVANCE in boiler practice during the last 25 years is strikingly illustrated by a contract just closed by Combustion Engineering, Inc., to furnish the boiler for a new generating unit at the State Line Station of the Commonwealth Edison Co. system.

Placed in service in the summer of 1929, this station attained widespread attention because it contained the largest steam turbine in existence — a 208,000-kw, three-element machine operating at 600 psi, 730 F superheat, with 500 F live steam reheat, and served by six 450,000-lb-per-hr sectional-header boilers.

The new cross-compound turbine-generator now on order will be of 191,000 kw — comparable in size to the earlier unit, but it will have only *one* boiler instead of *six*. The nominal steam conditions will be 2000 psig and 1050 F primary/1050 F reheat temperature at the turbine instead of 600 psi, 730 F primary and 500 F reheat. The boiler will be of the controlled-circulation, reheat type with a twin furnace, platen-type superheater and corner firing with tilting tangential burners for steam temperature control. It will be served by eight Raymond bowl mills and have three air preheaters of the Ljungstrom regenerative type. The continuous rated output of the unit will be 1,350,000 lb of primary steam per hour — a figure one half that of the combined output of the six earlier units supplying about the same turbine capacity.

What the Power Engineer Needs to Know About

Centrifugal Boiler Feed Pump Maintenance

In this article the author discusses routine maintenance programs as well as annual and semi-annual inspections

By I. J. KARASSIK,
Manager, Multistage Pump Section,
Centrifugal Pump Division, Worthington Corporation

THE ARTICLE IN THE June Issue of POWER ENGINEERING described the various considerations which need be studied in determining the frequency of a complete boiler feed pump overhaul. This article discusses the observation and maintenance procedures which should be carried out as part of a routine program in the power plant.

In general, since operators are on constant duty and since boiler feed pumps are located in fairly accessible areas (if not on the turbine room floor, as is becoming quite prevalent), hourly and daily observations should be made of the boiler feed pump operation. It is frequently the custom to enter capacity, pressure and temperature readings in the daily station log. These readings may even be complemented by such additional data as motor current input, bearing temperatures and other similar information. Examination of these readings will disclose any rapid reduction in performance and will be prime evidence that a more complete investigation is indicated. Regardless of what these log readings include, the most important precautionary measure is to be on the lookout for irregularities in the operation of the pump so that anything out of the ordinary may be reported immediately. Such irregular symptoms may consist of a marked change in the sound of a running pump, an appreciable increase in the vibration of the pump or a sudden change in bearing temperature. An abrupt change in the bearing temperature is a much more reliable symptom of trouble than a constantly elevated but steady temperature.

The operation of stuffing boxes should likewise be checked hourly. The stuffing box leakage should be sufficient to provide adequate cooling and lubrication of the packing but need not be excessive and wasteful. At the same time, it is important to realize that unless leakage can carry away the heat generated at the packing, the latter will burn and score the shaft sleeves. Therefore, if the stuffing box is provided with water quenching glands, the supply of quenching water must be turned off during this observation to be sure that the flow observed is strictly made up of stuffing box leakage and nothing else.

Inspections

Just as in the case of the frequency of complete overhauls, there appears to be a considerable divergence of opinion between pump designers as well as between operators on the subject of what maintenance and routine inspection procedures should be carried out semiannually and which annually. Fortunately, there is relatively little danger on the one hand if the time elapsed between certain scheduled procedures is lengthened from six to twelve months and there is also little excessive expense if, on the other hand, certain procedures are made twice as frequently as may actually be necessary.

The following recommendations represent a reasonable compromise between various accepted practices. Semiannually, the stuffing box glands should be checked for free movement and the gland bolts should be cleaned off and oiled. The packing should be inspected to determine whether it needs replacement.

The coupling bolts should be disconnected and the pump and driver alignment checked and corrected if necessary. The shaft end play should be checked during that operation. When the bearings are oil lubricated (whether sleeve or ball bearings), the oil should be drained out entirely, the system washed out and the oil renewed. Grease lubricated bearings should be checked to see that the correct amount of grease is provided and that it is still of suitable consistency.

A much more thorough inspection should be made of a centrifugal boiler feed pump once a year. In addition to the semiannual procedure, the bearings should be removed, cleaned and examined for flaws. The bearing housings should be carefully cleaned and washed out. Antifriction bearings should be examined for scratches and wear after cleaning. In order that neither dirt nor moisture may find their way into a ball bearing, it should be coated with oil or grease immediately after cleaning and, preferably, packed in clean rags or paper prior to reassembly. If the lubrication system includes an external oil cooler, the latter should be thoroughly flushed and cleaned along with all the small oil and water piping.

Unless prior experience has shown

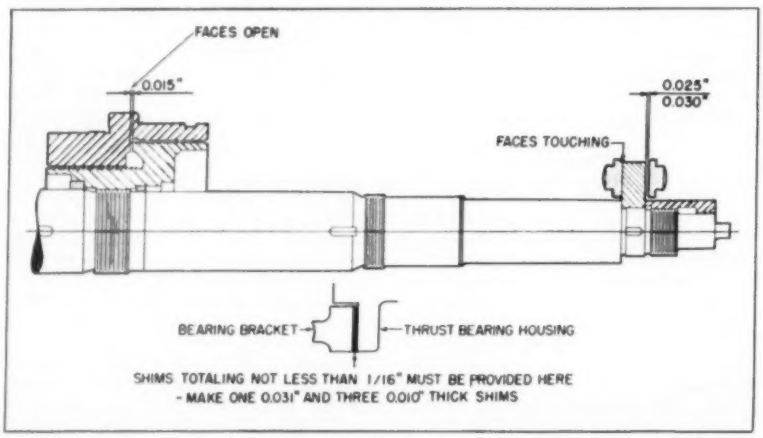

Fig. 1. Balancing disk position; thrust shoes on inboard side in contact with thrust collar. Entire axial clearance of thrust bearing is between thrust collar and shoes on outboard side in this position of rotor

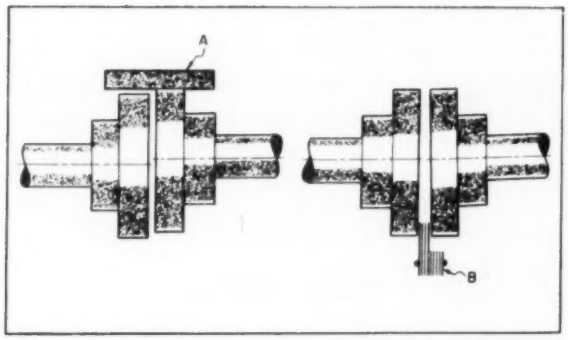

Fig. 2. Proper checking of couplings for proper alignment of pump and driver

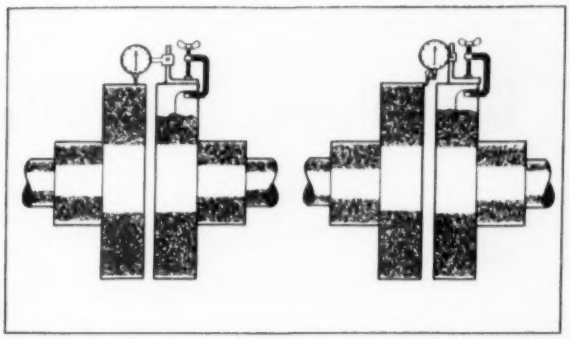

Fig. 3. Shows the use of the dial indicator for checking coupling alignment

that the stuffing box packing has a life considerably in excess of twelve months, the packing should be removed and the shaft sleeves thoroughly examined for wear. If excessive grooving appears, the indication is that the packing is unsuitable or improperly installed, that the shaft is bent or poorly aligned (so that it is running eccentrically) or that the glands are generally set too tight, resulting in insufficient lubricating and cooling leakage and excessive heat at the packing.

If the centrifugal boiler feed pump is fitted with babbitted sleeve bearings, the radial bearing clearances should be checked with the packing removed and the coupling disconnected. This is accomplished by checking the vertical shaft movement at both ends of the pump. A vertical movement in excess of 150 per cent of the original clearance will require that the bearing radial clearances be restored. The thrust bearing of a sleeve-bearing fitted pump is generally of the thrust collar and thrust shoes variety. The end play allowed by this thrust bearing should likewise be checked and if it exceeds the maximum recommended by the manufacturer, the cause of the excessive wear should be investigated and the axial clearances restored.

Balancing Device

If the pump is provided with a balancing device with axial clearance between the stationary and rotating parts, this clearance should be checked and reset in accordance with the manufacturer's recommended procedure. Generally, this consists in moving the rotor in a direction to close the axial gap between rotating and stationary parts, then moving it back a predetermined amount (varying from 10 to 15,000). In that position of the rotor, the thrust shoes on the inboard side should be in contact with the thrust collar and the entire axial clearance of the thrust bearing should be between the thrust collar and the thrust shoes on the outboard side. (See Fig. 1.)

If the couplings are of the all-metallic, lubricated type, they should be opened, cleaned and relubricated with the proper amount and consistency of oil or grease recommended by the manufacturer of the coupling.

The final check procedure involves the coupling alignment. While the manufacturer's instructions generally provide a description of the methods used to line up the pump and the driver, and while such descriptions have been very frequently presented in articles appearing in technical magazines, it remains advisable to present such a description here.

Coupling Alignment

Place a straightedge across the top and side of the coupling, and at the same time, check the faces of the coupling halves by means of a tapered thickness gage or feeler gages to see that they are parallel. (See Fig. 2.) For all checks of alignment, including that for parallelism of the coupling faces, both shafts should be kept pressed hard over to one side.

When the peripheries of the coupling halves are true circles of the same diameter and the faces are flat, exact alignment exists when the distance between the faces is the same at all points and a straightedge will lie squarely across the rims at any point. If the faces are not parallel, the thickness gage or feelers will show a variation at different points. If one coupling is higher than the other, the amount may be determined by the straightedge and feeler gages.

Sometimes coupling halves are not true circles and not identically of the same diameter. In checking the trueness of either coupling half, revolve it, holding the other coupling half stationary, and check alignment at each quarter turn. Next, revolve and check alignment of the coupling half previously held stationary. A variation within manufacturing limits may be found in either of the half couplings and proper allowance for it must be made when aligning the unit.

Instead of using a straightedge and feeler gage, dial indicators may be used to align the coupling halves (Fig. 3). The indicator is bolted to the pump half of the coupling and used to check both radial and axial alignment. With the button resting on the other coupling periphery, set the dial at zero and chalk mark the coupling half at the point where the button rests. For any check (top, bottom or sides) rotate both shafts by the same amount, i.e., all readings on the dial must be made with its button on the chalk mark. The dial readings will indicate whether the driver has to be raised or lowered or moved to either side. After any movement, check the coupling faces to see that they remain parallel to one another.

If the dial reading at the starting point is set to zero and the diametrically opposite reading at the bottom or sides shows a plus or minus 0.006 in. the driver has to be raised or lowered by shimming, or moved to one side or the other by half this reading.

When an extension coupling is used, a dial indicator should be used for checking the alignment. The extension piece between the coupling halves should be removed, exposing the coupling hubs. Using the coupling nut on the end of the shaft, clamp a suitable extension arm or bracket sufficiently long to extend across the space between the coupling hubs.

The dial test indicator is mounted on this arm and alignment checked both for concentricity of the hub diameters and parallelism of the hub faces. Changing the arm from one hub to the other provides an additional check.

Performance Test

An annual inspection should not be considered finished before a complete performance test is carried out on the centrifugal boiler feed pump. All instruments and metering devices used in such a test should first be recalibrated; only too often work is wasted because inaccurate test instruments are used. The performance data obtained from this test should be carefully compared with both the original pump test and with all the tests made subsequent to the installation of the pump and prior to the annual inspection in question. Should this comparison indicate either that the pump performance has fallen off to a point where further operation is uneconomical or that the rate of internal wear has suddenly become much more rapid than usual, a decision to carry out a complete overhaul is indicated.

The recommended procedure of a complete overhaul will be discussed in another future article.

Basic Power Plant FIGURING

By WILLIAM H. ENGELMAN
Mechanical Engineer, Cleveland, Ohio

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Degree-Day Method Helps You Estimate Next Season's Fuel Consumption for Your Building Heating System

THIS ARTICLE is presented as a guide and a method for the engineer who is interested in computing the approximate fuel consumption for a building heating system over a long period, employing the Degree-Day Method.

Now that one heating season is over, most engineers having building heating systems use the summer months to put everything in shape for next winter. And they usually make an estimate of the amount of fuel they may need for the next season, so it can be properly provided.

There are two principal uses of degree-day figures. One is in the comparison of the number of degree days in the current year with those in corresponding periods of previous years. For example, if a building used 1000 gal of oil during a certain heating season as compared with 850 gal for a previous season, we can obtain a comparison of the number of degree-days for the two seasons. This will indicate whether or not the increase is due to severity of weather (degree-days) since the fuel used should be proportional to the number of degree days for each period. The second use of degree-day data is to predict fuel consumption for a coming season, these uses will be explained later in this article.

What is Degree-Day?

Before we do this, however, let us establish and define the meaning of the degree-day. The American Gas Association has standardized the degree-day as equivalent to the number of days on which heat is required, multiplied by the temperature difference between 65 F and the average temperature for the period of days considered. For example, with an average daily temperature of 40 F, the degree-days in this case would be 25.

The National District Heating Association has made a very extensive study, with metered steam consumption on numerous buildings in various cities, and has found that the 65 F base standardized by the American Gas Association is fairly accurate.

The United States Weather Bureau for years has kept daily temperature records throughout the country. From these records, the Degree-Day Handbook has been prepared giving these data for numerous cities in each state. A fairly complete table of average monthly and yearly Degree-Days can be found in the Heating, Ventilating and Air Conditioning Guide, published by the American Society of Heating and Ventilating Engineers, 62 Worth St., New York 13, N. Y. (This book will be referred to hereafter as *The Guide*)

In the 31st edition of *The Guide* for 1953, just issued, the degree-day tables are given on page 437, included in Chapter 18, Estimating Fuel Consumption for Space Heating.

Degree-day tables are also given in the District Heating Handbook, 3rd Edition, page 336, in Chapter 11, Estimating Steam Requirements. The Handbook is published by National District Heating Association, 827 N. Euclid Avenue, Pittsburgh 6, Pennsylvania.

Predicting Fuel Consumption

If the degree-days occurring each day are recorded for a reasonably long period, the fuel consumption during this period as compared with another period is in direct proportion to the number of degree-days in the two periods. Therefore, for a given installation, the fuel consumption

Table I. Data on degree-days, showing fuel consumption and the average temperatures for the typical heating plant using month of January as basis

Item Number		A	B	C	D
Heating Season	Months	Degree Days	Per cent each Month	Gallons each Month	Ave. temp. each Mo. F.
Fall	September	93	1.53	1,052	61.9
	October	354	5.84	4,017	53.6
	November	684	11.27	7,753	42.2
Winter	December	1045	17.22	11,846	31.3
	January	1143	18.84	12,960	28.1
	February	1067	17.59	12,100	26.9
Spring	March	876	14.44	9,933	36.7
	April	553	9.12	6,273	46.6
	May	252	4.15	2,856	56.9
Total		6067	100.00	68,790	—

Table II. Right. An example of the degree-day method for estimating fuel consumption applied to an actual installation. The figures give representative boiler operating data for temperatures in a typical month of January using fuel oil.

A. Total degree-days for the heating season are 6,067.
B. Per cent for each month based on total degree-days.
C. Oil used each month is obtained from oil used in January, which amounted to 12,960 gals.
12,960 ÷ 18.84 is 687.90 gals for 1.0 per cent.
687.90 × item B is the oil consumed in any month.
Example: For October, 687.90 × 5.84 gives 4,017 gals of oil.
Total fuel oil is $\frac{12{,}960 \times 100}{18.84}$ = 68,790 gals for the season.
D. Average temperature for January = 65 − (1143 ÷ 31) = 65 − 36.9 = 28.1 F

1. Number of Degree-Days for the month	1143
2. Average daily temperature, F	28.1
3. Barometer reading, inches of mercury	29.53
4. Operating steam pressure, psig	10.5
5. Absolute steam pressure, psia	25.0
6. Steam quality assumed, per cent	99.0
7. Temperature of feedwater entering boiler, F	165.0
8. Actual steam generated, pounds	1,251,100
9. Heat furnished by boiler, Btu per pound	1,018
10. Factor of evaporation is 1018 ÷ 970.3	1.0492
11. Total equiv. evaporation is 1,251,100 × 1.0492	1,312,600
12. Total heat output is 1,251,100 × 1018	1,273,620,000
13. Fuel oil used, gallons per month	12,960
14. Heating value, Btu per gallon	137,000
15. Cost of fuel oil per gallon	$0.107
16. Total fuel cost per month is 12,960 × 0.107	$1386.72
17. Total heat input is 137,000 × 12,960	1,775,520,000
18. Cost per million Btu is 1,386.72 ÷ 1,775.52	$0.781
19. Boiler eff'y. is 1,273,620,000 ÷ 1,775,520,000	0.7173 or 71.73%
20. Btu per pound of steam is 1,775,520,000 ÷ 1,312,600	1352.7
21. Efficiency is also 970.3 ÷ 1352.7	0.7173 or 71.73%

can be calculated in terms of fuel used per degree-day for any sufficiently long period and can be compared with similar ratios for other periods to determine the relative operating efficiencies. It should be noted that the degree-day method for calculating fuel consumption for less than one month is of little value. This method of calculation is based on a long term average and cannot be expected to coincide with any single month or year in calculating fuel requirements.

From the tables in *The Guide* we see that the number of degree-days varies from city to city and in each city from year to year. Tables are frequently given showing the average temperature during the so-called heating season, arbitrarily set as the period from October to May. The heating season does not begin in all localities in October nor end on May 1. Using the average temperature for a normal heating season the total heat loss from a building can be determined for the entire heating season. After establishing the number of days the heating season lasts, the design temperature to be maintained inside the building, and the heat loss per hour per degree temperature difference, we need only to multiply the temperature difference per hour by 24 times the number of days in the heating season to obtain the total heat loss for the season.

Typical Heating Problem

For the purpose of explanation, let us consider a typical heating season, with data from the operating charts of a heating plant as in Table I.

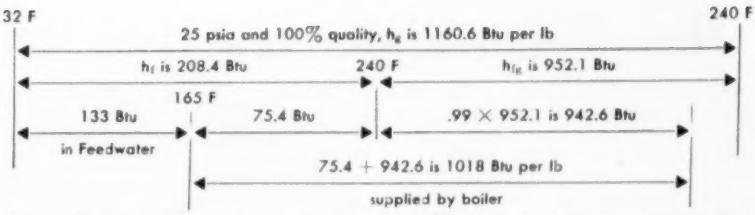


Diagram showing the relation of the water and steam Btu for the typical boiler described in the text

From the table and calculations, we see that the heating season considered is for a period from September 1 through May. The number of degree-days for the fall months, September, October, and November, varies widely, while the winter months, December, January, and February, are fairly even, going erratic again during the Spring months of March, April, and May. This pattern of variation is approximately constant over a normal heating season and would indicate that degree-day computations should be based on the average of the winter months, December, January, and February, when the degree-days offer a closer average in computing by this method.

Referring to Table I let us select the month of January from the heating season and compile the operating data for a heating boiler, based on the degree-day method. Knowing the degree-days for this month we can calculate the average monthly temperature as shown. Fuel oil used for 1143 degree-days in January was 12,960 gal. But 1143 is 18.84 per cent of the 6067 degree-days for the season, consequently 12,960 gal are also 18.84 per cent of the fuel used for the season. The total fuel oil used is then easily computed.

Let us see how to figure the heat supplied to the system by a typical boiler installation. Such an installation is tabulated in Table II.

Now to determine the heat per pound of steam furnished by the boiler. Operating steam pressure is 10.5 psig, therefore the absolute pressure is $29.53 \times 0.491 + 10.5 = 25.0$ psia.

Heat of the liquid h_f at 25 psia	208.4 Btu
Heat of evaporation h_{fg} at 25 psia is 952.1 and 0.99 (steam quality) × 952.1	942.6 Btu
Total	1151.0 Btu
Heat in feedwater above 32 F is 165 − 32	133.0 Btu
Net heat per pound of steam supplied by boiler	1018.0 Btu

It is helpful to clarify the above figures by the accompanying linear diagram.

In burning other fuels such as coal, coke, and gas, much the same method can be applied as with fuel oil.

Periodic Valve Inspection Saves Time and Money

PLANNED MAINTENANCE and inspection are the keys to longer valve life.

Primary failures to watch for are leakage past the disc when the valve is closed and leakage through the stuffing box.

Seating area leaks generally start insignificantly, but gain momentum quite rapidly. High velocities which are developed result in wire drawing and erosion of both the disc and seat.

If caught in time, this condition can usually be corrected by a comparatively simple regrinding or refacing operation on the seating surfaces, but if allowed to continue, complete failure is almost certain to result and replacement will be necessary, according to W. C. Hookway, in *C. A. Newscast*.

Another result of leakage past the seat is formation of condensate and subsequent water hammer. This, as with leakage past the packing in the stuffing box, can result in serious damage. With corrosive fluids, however, this failure is readily detected, particularly if the corrosive begins to attack the stem, bonnet, or other parts of the valve.

Maintenance department personnel, who are responsible for the upkeep of valves, can be either correctors or creators of valve problems. If the wrong tools or methods are used, there's bound to be trouble ahead. It is unfortunate indeed that pipe wrenches are so necessary in the tool kit of a maintenance man. When used for holding pipe, excellent results are achieved, but when this type of wrench is applied to a valve, damage results. Valves are designed with hexagonal surfaces wherever a wrench need be applied, so care should be taken to see that only flat faced wrenches are used.

Packing or stuffing boxes are generally designed with an adjustable allowance for packing wear. When this allowance has been completely taken up, the valve is ready for repacking. It is important at this time to remove all the old packing and replace it with new, and not just add additional packing. The reason for this is that the innermost packing is most subject to wear and consequently it usually needs replacing more than the outer packing.

A common fault among maintenance men is to remove stem packing with the tang of a file, a screw driver or some similar instrument. The result of this operation is often the marring of the stem and a subsequent leakage through the stuffing box, since the valve depends greatly on the surface condition of the stem for its tightness in the packing area. A score mark on the stem acts somewhat like a file as it passes through the packing, and packing life is obviously reduced.

There is available on the market today a simple device called a packing hook, designed to simplify the removal of packing and reduce to a minimum the possibility of damaging the stem. Its use is highly recommended.

The duties of a valve maintenance man should consist of routine inspection, adequate lubrication of moving parts to reduce wear to a minimum and improve performance, cleaning as required to insure proper functioning of all parts, repacking when necessary, and occasional regrinding or resurfacing of the seating surfaces. A planned program of valve maintenance will save money.

New Boiler Water Test Uses Ion Exchange Resin

NEW TEST for solids in boiler water, said to be comparable in accuracy and simplicity to the conductometric method, has been developed by Hall Laboratories, Inc., consulting engineering firm on water problems.

Essentially, the test involves mixing the boiler water sample with a strongly alkaline anion exchange resin, and titrating a portion of the resulting solution with acid to the proper end point.

A milliequivalent of hydroxide is formed for every milliequivalent of salt in the sample. The volume of standard acid required for the titration, multiplied by a suitable factor, gives an accurate measure of the dissolved solids in the sample.

H. M. Rivers and V. M. Marcy of Hall Laboratories described this method in a paper given before the recent Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy.

Two procedures may be used, depending on the degree of accuracy desired. With the dropper test, which can be made in two minutes, results are reproducible to 200 ppm dissolved solids. The more precise burette test requires about three minutes and gives results reproducible to within 25 to 50 ppm.

Complete dropper and burette test units, with enough reagents for about 100 tests, are available. For further information, ask the Editor of POWER ENGINEERING.

RESIN R
1. ADD HEAPING TEASPOONFUL OF RESIN R
2. ADD BOILER WATER SAMPLE TO MARK AND STIR FOR 30 SECONDS
3. DECANT SOLUTION TO MARK OF 1-OUNCE VIAL
4. ADD 2-3 DROPS OF PHENOLPHTHALEIN INDICATOR
5. ADD RESIN ACID SOLUTION ONE DROP AT A TIME UNTIL PINK COLOR IS DISCHARGED
6. PPM DISSOLVED SOLIDS EQUALS NUMBER OF DROPS TIMES 200

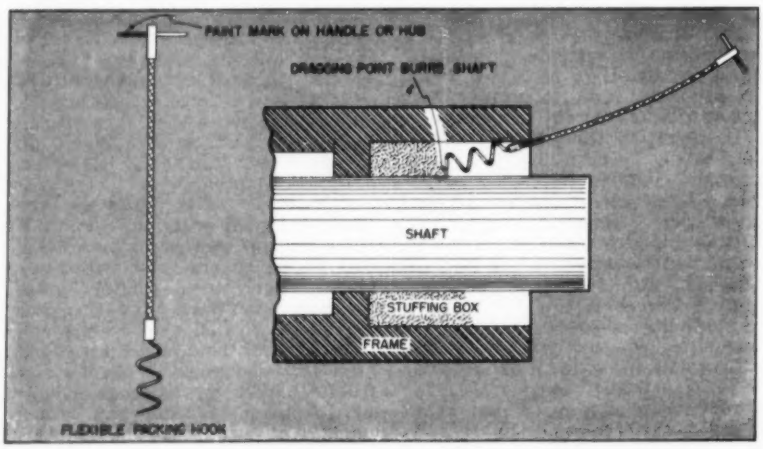
The step-by-step diagram, right, shows new test procedure using ion exchange resin to determine solids in boiler water, using the dropper method

"Think we should tell him that's his shoe string?"

Marked Packing Tool Prevents Shaft Damage

By H. NYE JOSLEYN

WHEN THE packing is removed from around a shaft, the packing tool's sharp point often scratches the shaft surface. This damage can be avoided by painting a mark on the tool handle or hub to show direction of the point, then making sure point is turned away from the shaft surface when used.



Does Your Water-Level Alarm Whistle Work?

By LUCIEN R. GREIF

Instructor, City College of New York

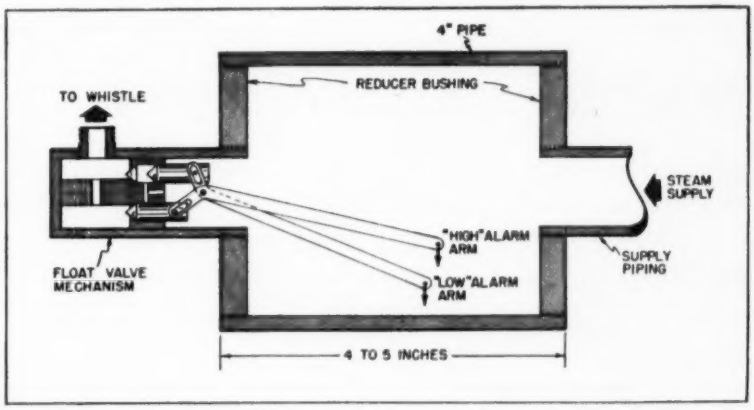
AMONG your most important boiler safety devices is the high-and-low-water warning whistle. It should be checked regularly to make sure it's in operating condition.

The easiest way to do this is with a spare. Substitute the spare, which you know to be in working order, for the one in the boiler. Check the one you've removed and keep it ready for future use.

If you have more than one boiler to service, install the spare on the first one, use the one you've taken out of the first boiler in the second one, and so on down the line, ending up with the whistle from the last boiler. In each case be sure the whistle works before reinstalling it.

To find out whether the whistle mechanism is in good shape without having to climb all over the boiler, make yourself the "whistle checker" shown in Fig. 1. From any convenient source, run a live steam line equipped with a shut-off valve. Connect the line to a steam chamber, made out of 4-in. piping about 4 to 5 in. long and threaded internally at both ends. Use reducing bushings until you can fit the chamber to the steam supply pipe at one end, and to the threaded whistle float valve at the other. If available, compressed air can be used instead of steam.

In checking the whistle, proceed as follows: Insert the whistle float valve into the chamber. (Remove the floats; the weight of the arms will activate the high or low water vents.) Turn on the steam or air supply. In the normal upright position the whistle should sing out if the "low-water" valve works, as shown in Fig. 1. Rotate the float valve mechanism in the steam chamber until the whistle is upside down to check the "high-water" valve; the weight of the float arm will open it, and at the same time close the "low-water" vent. The whistle should whistle.



Section through home-made whistle checker showing the whistle valve mechanism in position for testing. The operating arms, without the floats, are heavy enough alone to open and close the whistle valves

Can You Afford Combustion Control in Your Boiler Room?

TEN YEARS AGO, when premium-grade coal was available at a comparatively low price per ton, the main objective was to keep the steam pressure up regardless of the amount of fuel used or the efficiency. Six per cent of the fuel cost amounted to only a few dollars which, compared to the cost of combustion controls, made their consideration out of the question. Today, however, with the price of coal in the neighborhood of $10 a net ton delivered to the stoker and the price of automatic combustion control systems remaining comparatively stable, it is imperative that combustion controls be considered as a means of cutting ever mounting costs. The power engineer faced with the over-all problem of cutting costs naturally has to determine how much he can afford to spend for automatic combustion control. Experience has shown that annual fuel savings of over 10 per cent have been made through the use of automatic combustion controls.

The table prepared by the Fairmont Coal Bureau gives the yearly fuel savings which may be made through the use of combustion control systems for six different sizes of boilers. Using a conservative figure of 6 per cent saving of annual fuel bill, the power engineer can afford to purchase an automatic combustion control system costing an amount equal to that shown opposite the 6 per cent saving in the first column and under the size boiler which he is considering. A power engineer considering a 15,000-pound-per-hour boiler could afford to invest up to $1,530 for an automatic combustion control system and pay for the system the first year out of the savings in fuel costs.

With fuel prices rising steadily, more and more savings will be possible by using combustion control.

Table shows possible savings resulting from use of combustion control systems for various boiler sizes

	YEARLY SAVINGS IN FUEL *					
Savings (per cent)	5,000 lb boiler	10,000 lb boiler	15,000 lb boiler	20,000 lb boiler	30,000 lb boiler	40,000 lb boiler
1	$ 85	$ 170	$ 255	$ 340	$ 510	$ 680
2	170	340	510	680	1,020	1,360
3	255	510	765	1,020	1,530	2,040
4	340	680	1,020	1,360	2,040	2,720
5	425	850	1,275	1,700	2,550	3,400
6	510	1,020	1,530	2,040	3,060	4,080
10	850	1,700	2,550	3,400	5,100	6,800

* Based on coal at $9.50 per net ton. Evaporation at 10 lb steam per lb coal with boiler operating at rating, 12 hours/day, 300 days/year.

Questions and Answers

Your fellow engineers will answer your power engineering questions. You answer theirs, get paid well. Simple? Effective? Why don't you try it!

Question No. 509

How Repair this Leaking Pipeline?

HERE IS a problem we are having with a prefabricated, insulated steam and return line installation approximately 2000 ft long. This installation was made about 7 years ago and until last winter seemed to be giving excellent service.

But then, within a week's time, we had three breaks in the return line, in each case where the pipe passes through the concrete section plug. We can find no conclusive evidence that the leaks, seemingly caused by corrosion or electrolysis, were in any way caused by excess moisture getting into the lines.

The manufacturer of the pipeline disclaims any responsibility for the seemingly very short life of the installation, so our organization apparently will be forced to replace it or correct what seems to us to be a faulty design of having steel pipe in contact with a concrete seal.

Recently two leaks showed up in the steam line in comparable position to those found earlier in the return line. It seems to us that if we are to preserve our present investment in the line, we will have to open up each joint and knock out the concrete plugs to remove the contact with the steel pipe.

The question then arises: Will the insulation support the pipe or will typical pipe supports need to be provided. Also, can iron cement or some other chemical patch be applied satisfactorily to the pitted areas which will be exposed when the concrete plugs have been knocked out? Or will these need to be built up with a torch or completely removed to assure satisfactory service in the future?

H. M. P.

PRACTICAL HINTS AND KINKS

How about the gadget you made or the trick you used to do your job better? Write us about it. Send a sketch too. You will be paid well for contributions.

Flow Factor Chart for Comparing Fluid Flows

By JOHN D. CONSTANCE

THE ACCOMPANYING TABLE is presented as a convenient and time-saving tool for pressure drop conversions. After calculating the drop through a pipeline in the usual manner, the drop for the same flow through another or several other pipe sizes may be quickly checked for comparison.

Accuracy is within 5 per cent, for all practical purposes. The factors were calculated from the formula:

$$\text{Flow Factor} = \left(\frac{\text{Given pipe size (in.)}}{\text{New pipe size (in.)}} \right)^{4.8}$$

Sizes are nominal, but will hold for schedule 40 pipe. For other schedule pipe sizes, actual internal diameters may be substituted in the formula to calculate the different flow factors.

Example: Pressure drop for a 3 in. pipe is 5.47 psi. Find pressure drop for same flow through a 2 in. pipe of same material and schedule. From chart, Flow Factor is 7.0, since a greater drop is to be expected. Therefore, approximate drop for 2 in. pipe is 5.47 × 7.0 or 38.3 psi.

FLOW FACTORS—LIQUIDS—TURBULENT FLOW

x \ y	1½	2	3	4	6	8	10	12	14	16	18	20
1½	1	0.251	0.036	0.009								
2	3.95	1	0.143	0.036	0.005							
3	27.8	7.0	1	0.251	0.036	0.009						
4		27.8	3.93	1	0.143	0.036						
6			27.8	7.0	1	0.251	0.086	0.036				
8				27.8	3.93	1	0.343	0.143	0.068			
10					11.5	2.92	1	0.418	0.20	0.105		
12					27.8	7.0	2.4	1	0.478	0.251	0.143	
14						14.7	5.02	2.12	1	0.526	0.30	
16						27.8	9.55	3.93	1.882	1	0.57	0.343
18							16.8	7.0	3.34	1.74	1	0.601
20							27.8	11.6	5.57	2.92	1.65	1

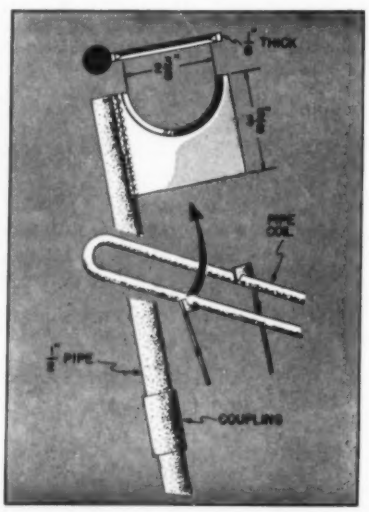
Knowing the pressure drop for a given pipe flow, this chart helps you quickly find drops for other flows

Scrapers for Refrigeration Coils

PROPERLY constructed tools help to remove built-up frost on refrigeration pipes and coils, and the same tools can be useful in removing scale from the tubes of fire tube boilers.

Two scrapers are employed, one for the upper half of the pipe or tube, the other for the lower half. Combining the cutting edges into one instrument is not recommended; it makes the tool weaker and clumsier.

To make scrapers for use on 2 in. refrigerated pipe coils, start with 3⅝ in. squares of 10 gage galvanized plate. Mid-way along one edge of each plate, cut a semi-circle larger than the outside diam of the pipe. Sharpen these half circles, beveling both sides to a dull knife edge. In welding the scraper blades to the pipe handles, keep their plane parallel with the pipe centers. This will allow the position of the pipe to show the angle of the scraping edge when in use. In practice, move the scrapers at about 45 deg to the work.



Home-made tool for scraping refrigeration pipes

Cut Steam from 100 psi to 2 psi Without PR Valve

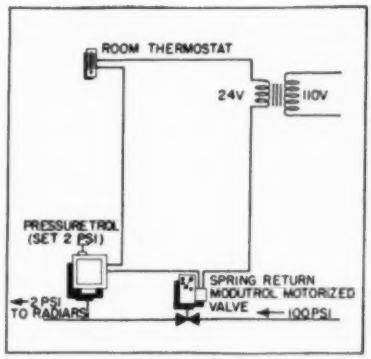
CARL E. WIGNER chief engineer, the Borden Co., Chicago, has a suggestion for you.

If you are using steam at 100 psi or so in your plant, and you'd like to use some of this steam to heat offices or other areas, you can install a thermostatically controlled system with just three components.

That is not unusual, admittedly, except for the fact that there's no pressure-reducing valve involved. The three components you need are a low-voltage room thermostat, a low-voltage Pressuretrol unit (0-15 psi) and a ½ in. low-voltage spring-return Modutrol motorized valve.

Put Them In This Way . . .

Connect the steam line, through the Modutrol motorized valve, to the present heating system. Then install the Pressuretrol unit, tapped into the line anywhere downstream from



Schematic diagram of pressure-reducing system

the valve. Wire the thermostat in series through the Pressuretrol unit and motorized valve, and set the Pressuretrol unit for 2 psi.

When the thermostat calls for heat, it closes the contacts in the circuit to energize the Pressuretrol and motorized valve. The motorized valve opens at the command of the Pressuretrol and maintains 2 psi steam through all the radiator lines.

Demand Satisfied, and Then . . .

As the demand for heat is satisfied, the thermostat breaks the circuit and the motorized valve returns to its closed position. It will remain closed until there is another demand for heat, when the process will repeat itself.

Not only is this system inexpensive to install, it is also easy on the maintenance budget, according to the report on it in *Industrial Control News*. It completely eliminates the necessity for the sometimes troublesome pressure-reducing valve.

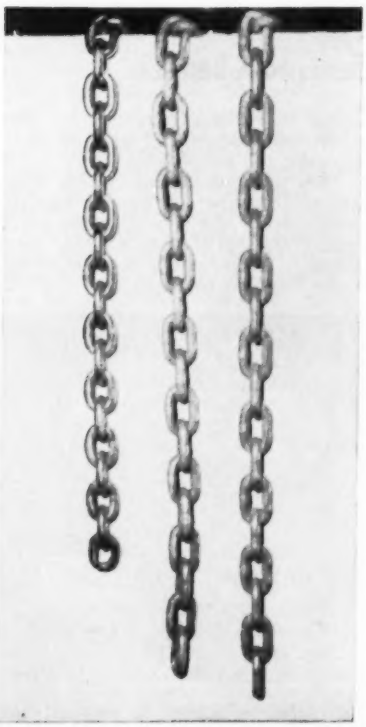
So?

So, wherever you have temperature and pressure control problems which interlock — as they frequently do — you may find it economical to put a system such as this one to work for you as an inexpensive solution. Since you can do the job reliably with these three components and save trouble in the long run, it seems well worth considering.

Use and Inspection of Chains

SAFETY in the handling of sling chains is being stressed at the Toledo plant of The National Supply Co., manufacturer and distributor of oil field machinery and equipment.

Chains are tested regularly for stretch, cuts and twists, which forecast future breaks. Charts have been distributed throughout the plant showing the safe working loads for the alloys used, and giving suggestions for using the chains properly.



The chain on the left is normal size; the other two lengths have both been stretched by overloading

The principle cause of chain damage is overloading, by either underestimating the load being handled, or by hooking on improperly.

The next most usual reason for chain damage is the cutting of the chain metal itself, by wrapping a chain over a sharp edge of a part being lifted. Wood blocking can be used to cushion the chain and prevent it from actually touching the sharp edges.

Another cause of cut or indented links is due to a whipping action of a casting or other part turning over.

Twists in chain legs may be caused by bent links. More often, twisted links are caused by a chain being stressed with a kinked link.

At the Toledo plant, Ted Steele has the responsibility of spotting chain defects. One of the requirements in making a good inspection is to hang a chain until its full length is suspended.

The hooks are then checked to see if they hang at the same elevation. Chains must measure the same as the length stencilled on the marking ring. The latter is a small ring attached to the bull-ring on which are stencilled the serial number of the chain and its length. The inspector also checks the openings of the hooks to determine whether the hook has been strained.

Visual inspection is very important. A glance at the hanging chain instantly tells if the links line up. If they are out of line, there must be a bent or twisted link.

A program of replacing wrought iron chains with those made of alloy steel has been adopted by the plant. They are stronger and less susceptible to damage.

Work Books for Maintenance Jobs

BY DONALD L. COCHRANE

IN A POWER PLANT where operators and maintenance men work shifts without a foreman, or work some distance away from their supervisor, here is an idea I have found works well in helping to keep track of every job assigned to these men.

I have a book for each man — a spiral notebook or small loose leaf is suitable — which I take with me on my daily inspections. Each book has on the cover the name of the individual to whom it applies. In these books, I write down the jobs to be done and any particulars concerning them. I designate the order in which they are to be done and the type of maintenance or operation ticket to be made out on completion of the job. If it is a two-man job, I designate it so in two books.

Push Button Protector

TO PREVENT unauthorized operation of hotel fans, hinged metal boxes were attached to the wall beside the push button stations. When locked, the boxes cover the buttons, and can be opened by authorized personnel only.

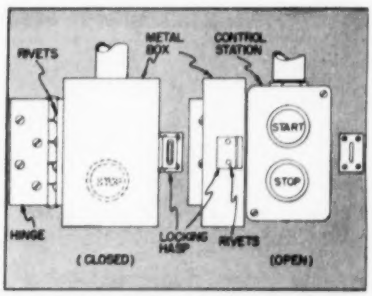


Diagram showing how push button protector works

Low Cost Insulation Covers Parallel Pipes

WHEREVER PIPES ARE parallel, close together and contain temperature-compatible materials, it is often economical and equally as effective to insulate the entire group as a unit. Most pipes go their own way in servicing power and process equipment and must be individually insulated. On the other hand, many parallel pipe runs are so short that the savings in group insulation are small. But the reduced cost of pipe insulation and application time becomes significant when two or more pipelines are parallel in long runs.

For example, the insulating method on a pair of parallel lines in a long elevated run at an eastern chemical plant is detailed in the drawing. Process steam at 40 psi, or 267 F, and molten sulphur at 284 F are carried in the two 4-in. pipelines on the right, the sulphur line being internally traced by a coaxial 1 ½-in. steam line.

Mineral wool blanket-type pipe insulation in 24-in.-long sections was wrapped around both pipes, laced tightly at the joint with 16-gage galvanized iron wire, and banded at about 12-in. intervals. A weather-resistant roofing-felt jacket was then applied over the insulation and also banded on 12-in. centers. Since the lines are entirely exposed, the insulation joint is located on the underside and the roofing felt is lapped downward about 3 in. Whether parallel pipes are indoors or outdoors and contain steam, molten sulphur, asphalt, water or any other hot material, flexible blanket-type insulation applied like this maintains temperatures efficiently for a lower first cost.

Fig. 1. Parallel lines in a long elevated run at an eastern chemical plant

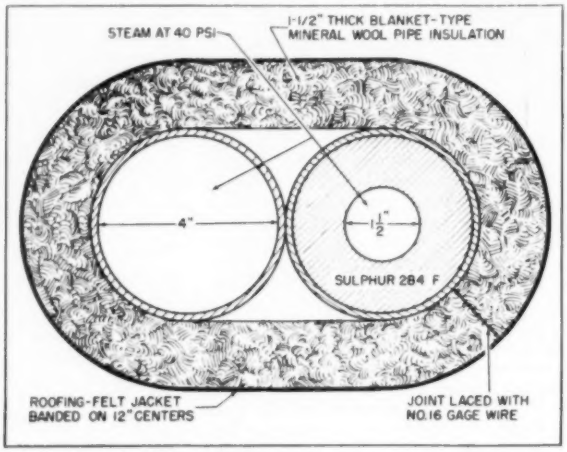

STEAM AT 40 PSI
1-1/2" THICK BLANKET-TYPE MINERAL WOOL PIPE INSULATION
4"
1½"
SULPHUR 284 F
ROOFING-FELT JACKET BANDED ON 12" CENTERS
JOINT LACED WITH NO.16 GAGE WIRE

Fig. 2. Section of parallel lines shows details of insulation application

These Pumps are Switched Automatically by Demand Changes

AN IMPROVED pump-sequence control system, automatically and efficiently adjusts the pumping capacity in multi-pump liquid delivery systems to meet the instantaneous demands in discharge lines regardless of how the demands fluctuate.

This system eliminates the disadvantages of attempting to operate the correct number of pumps manually. With manual operation, personnel are usually unable to maintain the proper balance between pumping capacity and flow rate because of demand changes.

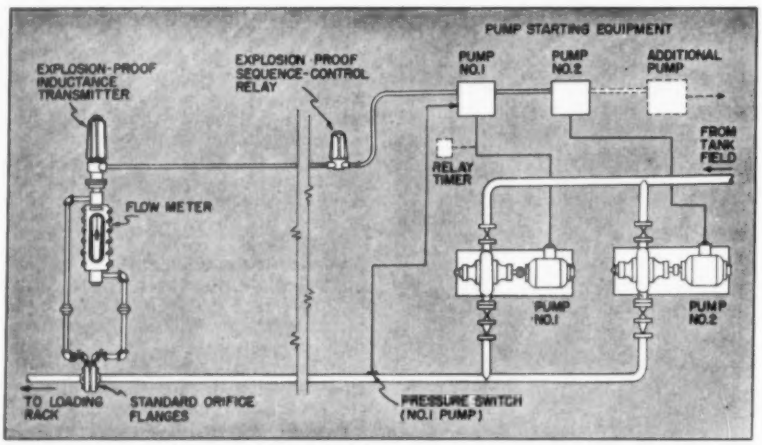
As soon as a discharge nozzle is opened, a pressure switch located in the discharge line senses the drop in pressure and turns on the first pump. This is the only pressure-sensing operation in the system. As the liquid moves through the line, a meter on a by-pass of the main discharge line measures the flow.

A meter float rises in response to the rate of line discharge; at the same time, a nickel alloy tube, mounted on the float, moves up into an inductance transmitter.

The transmitter contains a number of flat coils, spaced vertically. As the nickel tube moves up through the center of each coil, it changes the impedance in the coil. This impedance change is picked up by a simple Thyratron circuit which trips the starting switch for each successive pump motor.

Conversely, as the demand decreases, the float drops and the rod descends out of the field of successively lower coils, shutting off the unneeded pumps. All pumps shut off when the flow ceases.

This pump-sequence system is in use at a number of product loading terminals in this country. The most recent installation is at the new Benelux refinery just completed by Esso Standard in Belgium.



This is a schematic diagram of the pump sequence control system as described in text

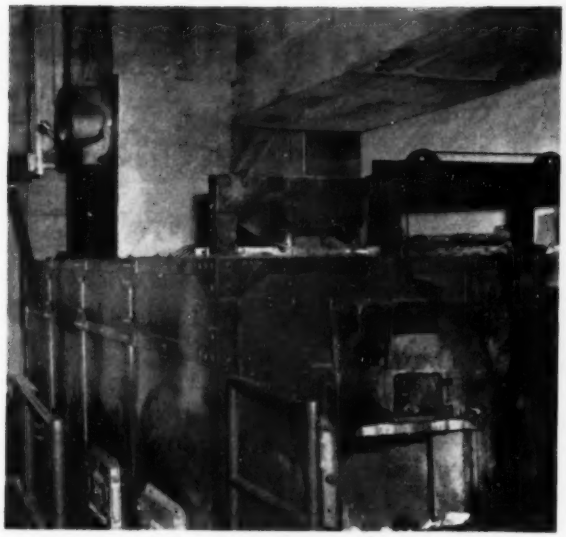


Fig. 1. General view of incinerator showing position of draft control damper

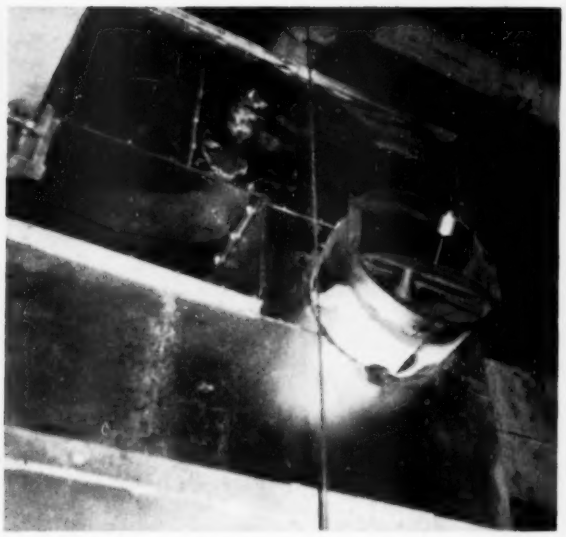


Fig. 2. A closer view of the balanced draft control damper seen in Fig. 1

That —! —! Incinerator!

Boiler draft is often upset by opening the door of an incinerator that uses the same stack. Here's a good remedy

TO THE MAN who has to burn dead dogs and wet garbage, the calorific value of the fuel is the least of his worries; often his problem is to burn it at all; and when he does his troubles are just beginning. Burning garbage makes a horrid smell, and practically the only way to get rid of it is to carry it up so high that it won't come down again.

For this reason, most incinerators are attached to the boiler house and make use of the boiler stack. The flue outlet from the incinerator is usually connected straight into the boiler breeching, as close to the stack as possible, and this leads to more trouble. If the boiler draft is adjusted with the incinerator door closed, opening the door upsets the draft; if the boiler draft is adjusted with the incinerator door open, closing the door upsets the draft.

The incinerator at Carson Pirie Scott and Co.'s department store in Chicago gave this sort of trouble until Chief Engineer Kimble eliminated it by installing a balanced damper in the incinerator flue to compensate for opening and closing the door. The damper, which fools the boiler into thinking the incinerator door is always open, is shown in Figs. 1 and 2.

The boiler draft is adjusted with the incinerator door open and the damper closed. When the door is shut, the change in draft automatically opens the damper, which allows the same amount of air as before to enter the incinerator flue. When the door is opened again the damper closes, so at all times the same amount of air is drawn into the boiler breeching, either through the incinerator door or the damper.

The photos on this page also show how partly burnt scraps of refuse are prevented from escaping. Fig. 3 shows the first of two firebrick baffles built right across the incinerator, one behind the other, just at the back of the combustion chamber. These two baffles catch most of the paper, ash, and scraps that would otherwise be carried by the draft into the stack.

As an extra impediment, the flue makes two right angle bends before it enters the boiler breeching. These bends can be seen in Fig. 2. It will be noticed that the incinerator flue joins the boiler breeching fairly high up. This allows rising boiler flue gases to pick up soot and ash separated out by the swirling turbulence created where the incinerator and the boiler flue gases converge. Lower convergence of the flows would allow soot to deposit on the stack floor.

Fig. 3. One of two firebrick baffles to prevent scraps being carried by draft out of incinerator

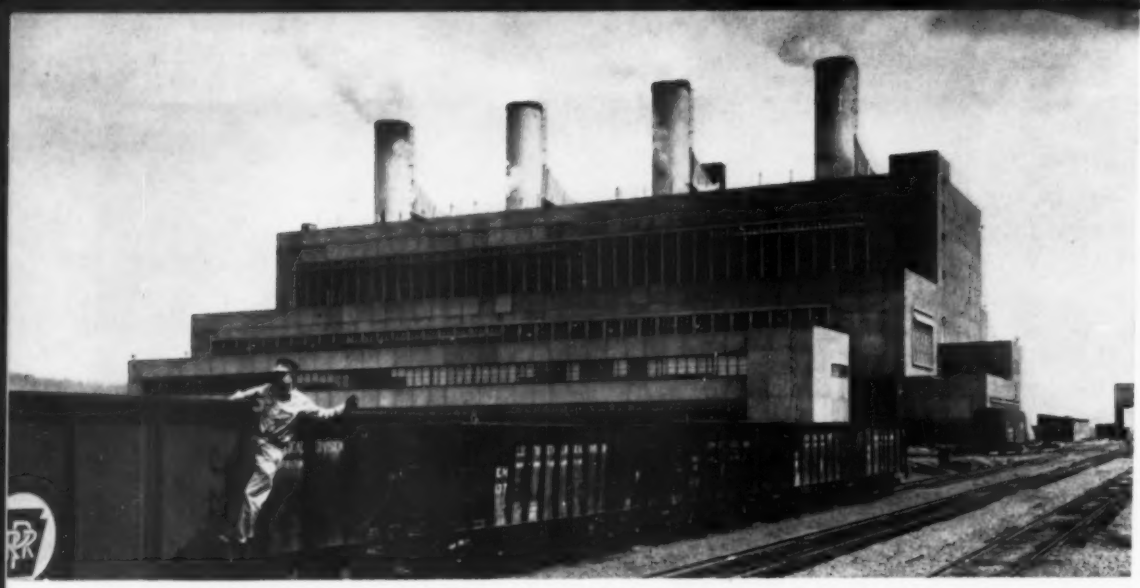


Fig. 1. New 200,000-kw industrial power plant of Electro Metallurgical Co. on Ohio River near Marietta, Ohio. Plant supplies power for great new Electromet production of ferrochrome and other alloys. Note wall panel construction. At left, behind plant, is 160,000-ton coal storage area

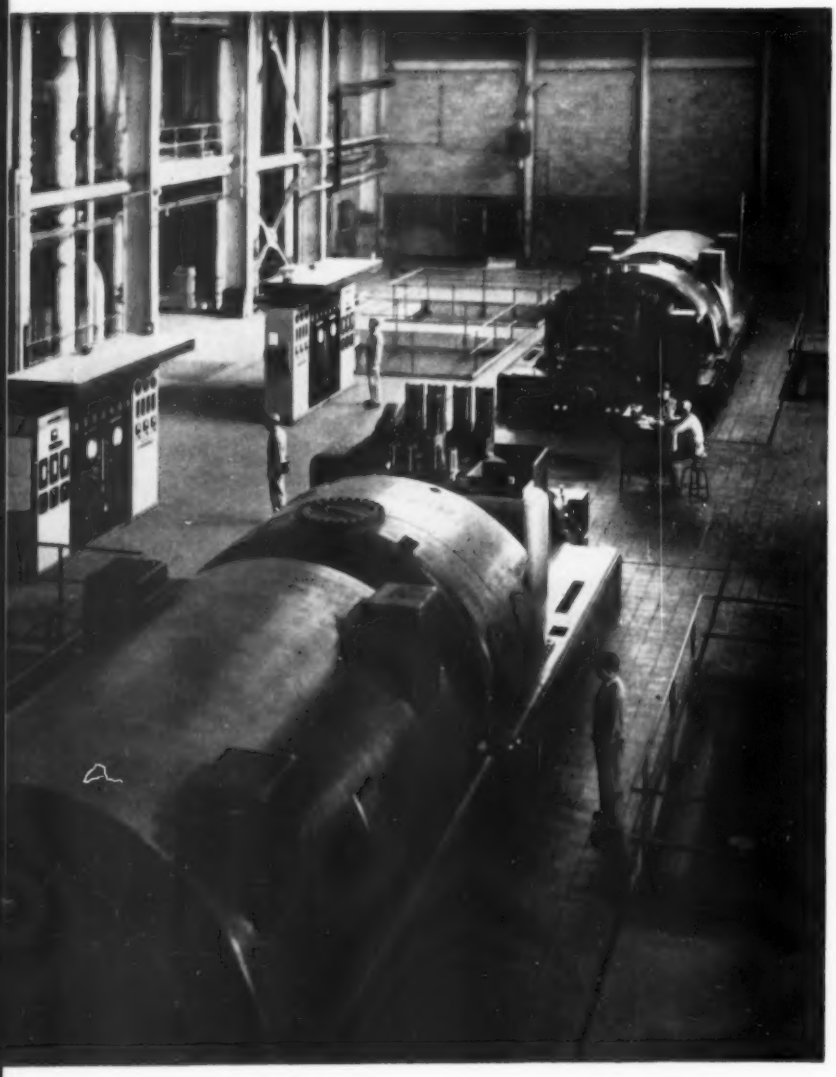


Fig. 2. Here are two of the four main turbine generators in the new Electromet power plant. Each hydrogen-cooled generator has nameplate rating of 40,000-kw, 13.8 kv. 3-phase, 60 cycle, but capability is at least 50,000-kw. These units supply electric power for huge electric furnaces and alloy-making processes, also supply turbine extraction steam to Bakelite Co. processes

Electromet's

DRIVING SOUTH along the beautiful Ohio River from the historic city of Marietta, Ohio, you approach the great new $100,000,000 plant of Electro Metallurgical Co., about 6 miles south of Marietta. Rounding a curve near the plant, first part of the development you see is a large concrete-paneled building, Fig. 1, surmounted by four steel stacks, a large coal storage pile to the south of it. This is the new power plant built to serve the great metallurgical plant now being completed at this site. On one section of the property is a plant of the Bakelite Co., both Bakelite and Electromet being divisions of Union Carbide and Carbon Corp.

Electric and Steam Demands

It is the combined electric power and steam load of these two plants that creates the need for one of the largest industrial power plants in the country. The entire electric and steam output of the plant will be required for industrial production.

Reasons for building this new Electro Metallurgical Co. plant at Marietta were (1) adequate coal supply only a few miles away; (2) ample water supplies, (3) ample supply of good workers.

Fig. 3. Control room of new power plant, showing bench board carrying operating adjustments, with recorders and indicators on vertical panel

200,000-kw Industrial Power Plant

The Electromet plant at Marietta, now in operation (although the final parts are still under construction) was built primarily to produce a unique steel alloying material, the new Simplex ferrochromium alloy for use in making stainless steels. The object is to produce a chromium alloy with virtually no carbon in it and in the new product the carbon can be kept as low as 0.01 per cent, whereas by other methods it might average 0.03 per cent. This is a reduction of carbon to $\frac{1}{3}$ its former value and is important in the manufacture of stainless steel.

Big Electric Load

To produce this new alloy and others (such as ferromanganese) electric furnaces are used, also large electrolytic cells for producing electrolytic chromium and electrolytic manganese. These, together with the associated auxiliary motors, material-handling equipment, lighting and other equipment, consume large amounts of electric power. The plant of Bakelite Co. at one end of the property, in addition to electric power, consumes large amounts of process steam. In addition, great quantities of river water must be supplied to the processes.

All these services must be supplied by the new power house of Fig. 1. Principal equipment installed in it consists of four 40,000-kw (nameplate rating) single automatic extraction-condensing turbine generating units. These have hydrogen-cooled generators and direct-connected exciters and their maximum capacity is far beyond the nameplate rating, so that the plant is considered a 200,000-kw plant.

Steam Generating Units

These units are supplied with steam at 1250 psig, 950 F by four pulverized-coal-fired steam generating units each designed for 650,000 lb per hr of steam, maximum design pressure 1475 psi, 950 F.

Each turbine is equipped with a controlled extraction point from which steam at 275 psi is transmitted through an underground piping system to the industrial processes. An underground electrical distribution system is also used.

Electric generation is at 13.8 kv and the power is transmitted to the industrial plant at that voltage, and stepped down as required. An outdoor 13.8/132 kv substation is provided from which a tie line connects with the local utility at Marietta.

Part of the coal comes from the company's mines about 25 miles away. It is delivered in hopper bottom cars, dumped to track hoppers, then flows on a belt conveyor to a crusher, thence either to power plant bunkers or to the storage pile, in which about 160,000 tons are normally stacked.

Coal and Ash Handling

Coal for storage is distributed and compacted in the pile by bulldozers in the standard way. Car shakeouts and gas-fired car-thawing pits are provided for handling frozen coal.

Each boiler is equipped with four ball mill pulverizers, a regenerative type air preheater, a mechanical type dust collector, forced and induced draft fans. The boiler breechings lead up through the roof and along it to stacks 60 ft high, supported on the building steel work. In each stack is a hopper bottom below the breeching connection, to collect fly ash that drops out at the turn. This fly ash is picked up by a vacuum ash conveyor system that delivers it to the main ash handling system below in the plant basement.

This ash-handling system receives ash from the dry-bottom hoppers of the boilers and sluices it to an ash disposal pit on the plant property some distance away.

(Continued on page 104)

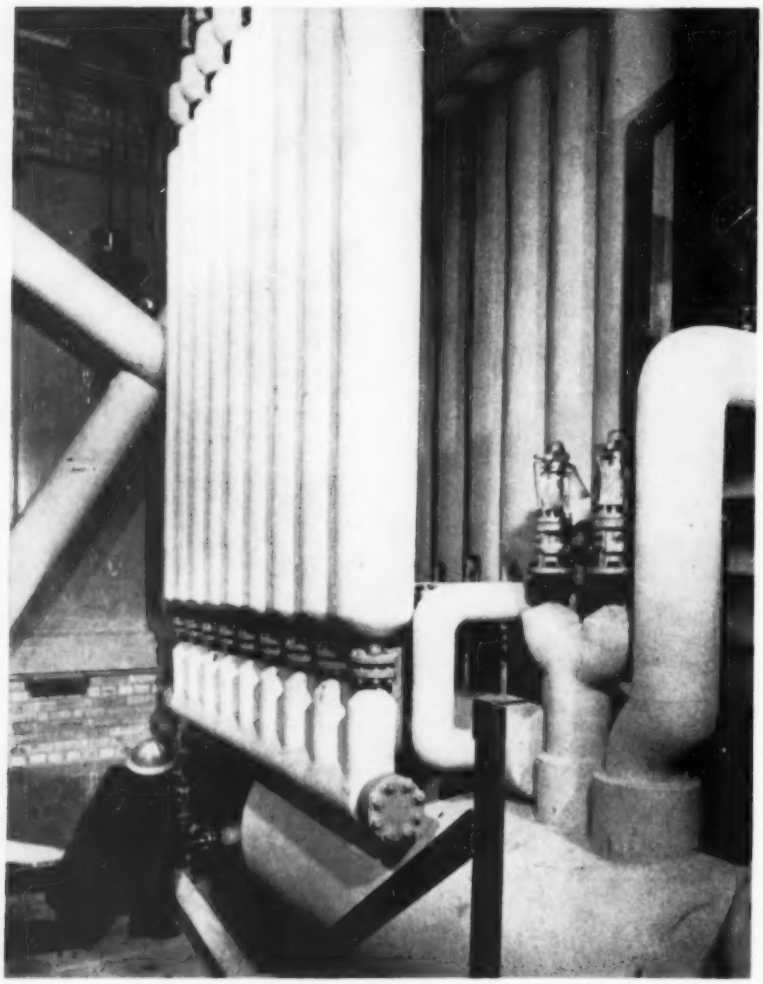
Sources of Information on Atomic Power

Many engineers desirous of learning more about the development of Atomic Power may have had difficulty in knowing where to turn for information. Sources listed on these pages will be found helpful to those interested in both general and technical aspects of this new field

By **ANDREW W. KRAMER,** Editor, POWER ENGINEERING

RELEASE of the declassified Reports on Power Reactor Feasibility by the Industrial Study Groups announced in the June issue for the first time gave power engineers, in a single package, specific information and data on the practical development of power from nuclear energy.

Until the release of these data, engineers have had difficulty in obtaining information on atomic power; first because much of the essential information was (and still is) classified; and second, because the unclassified literature is scattered and not very well organized for easy reference.



There exists, however, a great deal of technical literature relating to the fundamentals of nuclear power development that should be of value to power engineers, if only they knew where to find it. Indeed, this existing store of data becomes even more valuable now that the reports on power reactor feasibility have been released, since it provides the background material against which these recent reports can be evaluated.

Some of this existing literature is necessarily of a highly scientific nature, since it deals with nuclear physics; but much of it is understandable to the average engineer who has an interest in atomic power. The basic principles of nuclear power development are quite simple; indeed, in some respects the operation of a nuclear reactor is simpler than that of a modern fuel-fired steam boiler. The fission of uranium by neutron capture is no more complex than the chemical reaction between carbon and oxygen in the combustion of coal or oil. Once the basic concepts are understood, the development of atomic power equipment becomes largely a matter of applying engineering principles; methods of solving difficult heat transfer problems developing systems for handling solids, gases, and fluids, problems involving the mechanical arrangements for feeding fuel and disposing waste material. Much progress has been made in the solution of such problems and most of the data has been incorporated in the form of reports and technical papers and books.

There is available, for example, a bulky volume, published by the U. S. Atomic Energy Commission known as TID — 5031 and entitled, "The Role of Engineering in Nuclear En-

View of the steam generator developed at Argonne National Laboratory for use in connection with the Experimental Breeder Reactor. This generator receives its heat from a liquid-metal coolant from the nuclear reactor. It produces steam at 400 psi, 550 F. The steam is used to operate a turbine generator supplying the 170 kw which are required to meet all the power demands of the building in which it is housed.

ergy Development". Actually, this volume constitutes the proceedings of the Third Annual Oak Ridge Summer Symposium. This 509-page book, which sold for $1.40 at the time it was issued in December 1951, in itself provides all the possible data and basic information on nuclear energy and nuclear power development that the average engineer needs at this early stage of development. This book is available from the Office of Technical Services, Department of Commerce, Washington, D. C.

Another book that engineers interested in atomic power will find of great value is the "Liquid-Metals Handbook" issued jointly by the Office of Naval Research and the AEC. This book is on sale at the Office of the Superintendent of Documents, U. S. Government Printing Office at Washington at a price of $1.25. As is generally known, liquid metals offer unique advantages in methods of heat transfer in power reactors and this book provides a wealth of data and information on the characteristics of various liquid methods and methods of handling them. There are, for example, very detailed descriptions of the various types of electromagnetic pumps in this volume. It was compiled for use both inside and outside atomic energy and military projects and it summarizes information which has been assembled over a period of years during which interest has grown in the use of liquid metals as heat-transfer media.

As an example of the practical application of liquid metals heat-transfer technique, the accompanying photograph of the steam generator for use with the Experimental Breeder Reactor is of interest. Actually, this constitutes the *boiler* in an atomic power plant. It differs greatly in appearance and, in some regards, in construction from conventional steam producing systems. In addition to assuring high steam generating efficiency, it contains unique design features, which prevent the mixing of the reactor's alkali metal coolant and water or steam which, in contact, react violently. This steam generator, developed at Argonne National Laboratory, produces steam at 400 psi and 550 F.

Many of the basic data underlying the development of steam generators of this type is contained in the Liquid-Metals Handbook. Engineers interested in the design of steam generators of this type by all means should have this book.

In general, the available data on nuclear energy are to be found in three categories of literature: first in the publications issued by the U. S. Government, notably by the AEC itself; second, in books on the subject published by the technical book companies; and, third, in numerous papers and reports presented before technical societies, and in articles in technical magazines.

General Publications and Papers

An International Bibliography on Atomic Energy. Volume 2, Supplement No. 1, Scientific Aspects. Published by the Atomic Energy Section, Department of Security Council Affairs, United Nations, New York, 1952. This volume together with supplements which are published periodically, is without question the most complete list of source material on the scientific aspects of atomic energy in the world. It includes scientific papers and articles from society proceedings and technical papers the world over. The Atomic Energy Section of the United Nations Secretariat has checked almost all the items listed against the original publications to insure their accuracy. Volume 2 published in 1951, is available at $10.00. Supplement No. 1 issued in 1952 is priced at $3.50.

★ ★ ★

Nuclear Science Abstracts. Issued twice a month by the AEC Technical Information Service and is available from the Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C. Price 25 cents per copy or $6.00 a year. This publication contains abstracts of all current AEC declassified and unclassified reports of non-AEC reports relating to atomic energy, and of articles appearing in both foreign and domestic periodical literature.

★ ★ ★

The Role of Engineering in Nuclear Energy Development. TID-5031. The Proceedings of the Third Annual Oak Ridge Summer Symposium. Available from the Office of Technical Services, Department of Commerce. Price $1.40. This 507-page mimeographed book contains a wealth of data and information on both the practical and theoretical aspects of nuclear energy. It is divided into four divisions, as follows: 1. General. 2. Scientific Background. 3. Engineering Aspects, and 4. Panel Discussion. Power engineers will find a great deal to interest them not only in the divisions on Engineering Aspects but also in the division concerned with the Scientific Background.

★ ★ ★

Liquid-Metals Handbook. This most useful and interesting book is intended as a guide to the use of liquid metals as heat-transfer media. It was compiled by the Department of the Navy and the Atomic Energy Commission and summarizes current information on the physical and chemical properties of liquid metals, their present industrial uses, and their potentialities as heat transfer media. Of particular interest to engineers the section on large-scale handling of some liquid metals, which includes detailed descriptions of various electromagnetic and other special types of pumps that have been developed. Since there seems little doubt that liquid metals will play a vital role in the operation of future atomic power plants, this book has considerable value to those concerned with the design of these plants. This 188-page book is for sale by the Superintendent of Documents, Washington, D. C.

★ ★ ★

Course in Nuclear Physics for Engineers. (MDDC-1104) Compiled by Dr. Carl Helmholz at the University of California and issued by the Technical Information Division, Oak Ridge Operations Office, AEC. This highly technical series of lectures will not be of much value to those not having a good grounding in mathematics and physics but it provides excellent descriptions of the operation of all types of particle accelerators as well as basic material on the nature of nuclear particles and their interaction with radiation. This series was issued in 1949 and sold at a price of 50 cents.

★ ★ ★

Lecture Series in Nuclear Physics. (MDDC-1175) This document, for sale by the Superintendent of Documents, Government Printing Office at Washington, D. C., at a price of 55 cents, was prepared in September 1943 for use at the Los Alamos Scientific Laboratory and was declassified in October 1945. While certain portions are rather difficult, the lectures as a whole are quite readable, and those interested in basic principles will find much to help them in understanding nuclear phenomena. The course comprises six groups of lectures classified as follows: 1. Terminology. 2. Radioactivity. 3. Neutron Physics. 4. Two-body Problem. 5. The Statistical Theory of Nuclear Reactions. 6. Diffusion Theory. These lectures are more understandable to the average engineer than MDDC-1104 referred to above.

★ ★ ★

Neutron Physics. (AECD-2664) A revision of I. Halpern's notes on E. Fermi's lectures in 1945 by J. G. Beckerly. Professor Fermi gave a course in Neutron Physics as part of the program of the Los Alamos University. Dr. Beckerly's revision is based upon class notes prepared by I. Halpern. The material is quite technical and of little interest to those not interested in the theoretical aspects of neutron physics. There is much in these notes of value to students of *pile engineering*. This document is issued by the Technical Information Branch at Oak Ridge, Tenn. at a price of 35 cents.

★ ★ ★

Atomic Power and Private Enterprise. This is a book printed for use by the Joint Committee on Atomic Energy and printed in December 1952 by the U. S. Government Printing Office. It is a 415-page collection of miscellaneous articles and addresses by scientists, engineers, government officials, etc., on the development of power from nuclear energy. The collection as a whole provided an extremely interesting cross section of thinking on the subject, and the articles should be read by everyone seriously interested in atomic power.

★ ★ ★

Selected Readings on Atomic Energy. This is a bibliography of official publications, books, magazines, pamphlets and teaching units for educators, and indexes and bibliographies on atomic energy. It was published in August 1952 and is available from the Superintendent of Documents for 15 cents.

★ ★ ★

Harwell, The British Atomic Energy Research Establishment, 1946–1951. This is an interesting book describing the history and the development of the British Atomic Energy Research Establishment at Harwell. It gives excellent, well illustrated descriptions of the various reactors and also details of the high energy accelerators used at the laboratory. This book is published in the United States by the Philosophical Library, 15 East 40th Street, New York, N. Y. Price $3.75.

(More on next page)

Books on Atomic Energy

Sourcebook on Atomic Energy. By Samuel Glasstone. Published by D. Van Nostrand Co., 240 Fourth Ave., New York, N. Y. Price $3.40. This 546-page book brings together for the first time in one readable narrative the important facts about the past history, present status, and possible future of atomic science. Without oversimplification, without popularizing it unfolds the spectacular story of the greatest achievement of modern science. Chapters are included on the structure of the atom, radioactivity, isotopes, neutron research, acceleration of charged particles, and other phases of nuclear science. Dr. Glasstone prepared this volume under the direction of the U. S. Atomic Energy Commission.

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The Elements of Nuclear Reactor Theory. By Samuel Glasstone and Milton C. Edlund. Published by D. Van Nostrand Co., New York, 1952. Price $4.80. This is a book for scientists, engineers, and advanced students interested in the field of nuclear reactors. It explains the physical concepts and processes involved in a nuclear chain reaction and the methods for calculating critical conditions for chain reacting systems. For those unfamiliar with the basic nuclear physics, four introductory chapters are included to provide an understanding of the physical processes occurring in a nuclear chain reactor. The main body of the book is devoted to the fundamental principles involved in the calculation of the critical conditions for thermal neutron chain reacting systems. The mathematical derivations are carried out in considerable detail.

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The Science and Engineering of Nuclear Power. Vols. I and II. Edited by Clark Goodman. Published by the Addison-Wesley Press, Inc. Cambridge 42, Mass. 1947 and 1948. Price each volume $7.50. These two volumes contain the essentials of a series of seminars initiated at the Massachusetts Institute of Technology in October 1946. They present the fundamentals of chain reacting systems in terms that are understandable to the non-specialist, particularly to engineers interested in the industrial applications of nuclear energy. The material was all submitted to the AEC for review and declassification and is approved by the Commission from the standpoint of security. The usefulness of these two books to the engineer seriously interested in the field of atomic energy for industrial use cannot be overemphasized. They represent the work and thinking of some of the most notable workers in the field, and are written in a way so as to be of distinct use to engineers.

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The Atom Story. By J. G. Feinberg. Published by the Philosophical Library, 15 East 40th Street, New York, 1953. Price $4.75. This, without doubt, is one of the most fascinating books ever written on the subject of Atomic Energy. The only other book comparable to it, curiously enough, is a book with almost the same title — John W. Campbell's book, written in 1947, called "The Atomic Story." Both books start at the beginning, that is, with Democritus' ideas about the atomic structure of matter. Dr. Feinberg's book reads more like a novel than a scientific treatise, and for anyone who is unfamiliar with the history and development of atomic physics, this book is a MUST. It tells the whole fascinating story; describes the long hard road by which we have gained knowledge of the atom, and in particular presents a detailed account of the events that led to the development and production of the atomic bomb. This is not a scientific book but it is one which has in it a great deal of fundamental information. In clear nontechnical language, Dr. Feinberg brings the reader step by step along a journey of adventure and discovery as intriguing as a well-told cloak and dagger yarn; which, in effect, is what it is. We cannot recommend this book too highly.

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The Atomic Story. By John W. Campbell. Published by Henry Holt & Co., 257 Fourth Ave., New York, 1947. Price $3.00. As implied in the comments on Dr. Feinberg's book, The Atom Story, this book by John W. Campbell is a fascinating account of the history and development of atomic energy from the earliest pronouncements of the Greek philosophers to the explosion of the atomic bomb over Hiroshima. It is written by a man who knows his science. John Campbell is the editor of Astounding Science Fiction and in 1938 in an editorial in this magazine he stated, "You can be fairly certain of this: *the discoverer of the secret of atomic power is alive on earth today.* The italics appeared in the original editorial. Six months later, Hahn and Strassman's discovery of the fission of uranium was announced; 5 years before that Fermi had detected the formation of radioactive fission products. Campbell's editorial prophecy was possible because all the basic laws of nuclear physics had been outlined by 1938.

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Uranium, Plutonium and Industry. Published by The American Society of Mechanical Engineers, 29 West 39th Street, New York, 1953. Price $1.50. This little 48-page book presents a summary of the U. S. Atomic Energy Program. It had its origin in a little booklet "Catching up on Atomic Energy" prepared by the Vitro Corporation for Waddell & Reed, Inc. The continuing need for some form of run-down of the atomic energy program led the Nuclear Energy Application Committee of the ASME to undertake revision and enlargement of the booklet to meet the needs of engineers. The result was this book. It is an excellent little book providing the background information that many engineers unfamiliar with this new field will find of value.

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Lectures on Atomic Energy Industrial and Legal Problems. Published by the University of Michigan Law School, Ann Arbor, Mich. This book contains the series of lectures delivered at the University of Michigan Law School, June 26–28, 1952, by a number of specialists, including Dr. Lawrence Halfsted, Director of Reactor Development, AEC; Walker L. Cisler, President, Detroit Edison Co.; J. Lorne Gray, General Manager of the Atomic Energy of Canada, Ltd; Clark E. Center, General Manager, Atomic Energy Div., Carbide & Carbon Chemicals Corp., etc. The book concerns itself with the industrial and legal problems arising in connection with the peacetime uses of atomic energy. It is non-technical and very readable.

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Applied Nuclear Physics. By Ernest Pollard and William L. Davidson. Published by John Wiley & Sons, 440 Fourth Avenue, New York, 1951. Price $5.00. This second edition of this book provides an interesting and concise explanation of nuclear physics and its progress since 1942. It gives a clear picture of practically all phases of nuclear science including the basic facts of nuclear particles and radiations and methods of accelerating them, transmutation, natural and artificial radioactivity, isotopy and nuclear fission. For several years this was one of the few available books on atomic physics and is still among the best. The use of mathematics is very limited and the book should be of distinct value to engineers and engineering students.

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Atomic Energy. By Karl K. Darrow. Published by John Wiley & Sons, 440 Fourth Ave., New York, 1948. Price $2.00. Anybody who knows Karl Darrow knows of his rare ability to state complex things in simple language. This book is no exception; in it Dr. Darrow tells the basic facts about atomic energy in his own fascinating, inimitable way. Actually this little book (80 pages) represents the Norman Wait Harris lectures which Dr. Darrow delivered at Northwestern University in 1947. There are five lectures in all, and all equally intriguing.

★ ★ ★

Elementary Nuclear Theory. By H. A. Bethe. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, 1947. Price $2.50. This book is not meant as a textbook, rather it is a consideration of certain topics in the theory of nuclear physics, and even these topics are treated in only an elementary way. Dr. Bethe has been professor of physics at Cornell University since 1935 and to him is due our understanding of the carbon-nitrogen cycle in the sun whereby hydrogen is being transmuted to helium, thus accounting for the release of the sun's energy.

★ ★ ★

Introductory Nuclear Physics. By David Halliday. John Wiley & Sons, Inc., New York, 1950. Price $6.50. This is probably one of the most elementary of the newer textbooks on nuclear physics. It gives a descriptive treatment of the important problems, modern facts, and pertinent philosophy of nuclear physics. The author was particularly concerned with stressing only that material consistent with modern thought on nuclear physics. It is designed as a textbook for a beginning graduate course in nuclear physics or (by omitting the material in fine print) for an advanced undergraduate course. Hence, the book should be equally useful to practicing engineers wishing to learn something about the basic principles of nuclear physics.

In the adjoining columns are listed a number of the most useful books and government publications on the subject of atomic energy available at the present time. Some of these treat the subject from a highly theoretical standpoint, others from a practical standpoint. Some read more like novels than scientific treatises, but all can contribute to one's better understanding of all aspects of this fascinating new field.

As in many new fields of development, many engineers out of college for a number of years are more or less confused in their approach to the nuclear field. It is as though their mental processes have become benumbed by the shock of the atomic bomb, by the almost inconceivable release of energy, and the mysterious way in which the atomic bomb was developed. The security restrictions surrounding every phase of the AEC operations have imparted a sense of frustration to those who, at heart, have a keen interest in matters of this kind. Many individuals do not seem to realize how much non-classified and unclassified material is available. True, the AEC reactor technology is largely top secret, yet an immense amount of basic information is available to those who take the trouble to go after it.

As an example, it was only during the summer of last year, 1952, that articles appeared in the technical press about the electromagnetic pump used in connection with the breeder reactor developed at Argonne Na-

(*Continued on page 105*)

Coatings Cut Corrosion Costs

Remarkable progress has been made in corrosion resistant metals and metallic coatings. The author explains how corrosion can be prevented by their proper selection

By L. G. JONES

Do You Want More of These Paint Articles?

THE PRESENT ARTICLE is one of a number of related articles on how to test paints and coatings for a wide variety of power plant equipment. These articles give the results of years of work on the subject by L. G. Jones, material research engineer for one of our leading private utility companies. Here is what they cover:

Test Your Power Plant Paint—published October 1952 issue

In Your Power Plant Painting Program, Make Simple Reflection Tests—published December 1952 issue

How Does Your Power Plant Paint Reflect Heat?—published February 1953 issue

Coatings Cut Corrosion Costs—scheduled for July 1953 issue

Future Articles

How to Use Color for Identification
How to Use Color for Public Relations
Coating Fiber Materials
Paints for Protecting Metals
Electrolytic Corrosion and Coatings
Selection of Non-Metallic Protective Coatings
Organic Finishes
Effect of Heat on Paints
How Much Does Painting Cost?

After seeing the articles already published, would you, as a POWER ENGINEERING reader, prefer to have the whole group

1—Published in POWER ENGINEERING as separate articles running over the next 12 to 18 months, or

2—Published all together as a special 32 page booklet, to be sent on request without charge to readers requesting it

Write the Editor, telling him first whether such articles would be helpful to you and if so, whether you prefer plan 1 or 2. Write on your company letterhead, if possible; in any case be sure to give us your name and address.

THE PAINT USED to coat a piece of equipment usually costs less than any of the materials used in its manufacture, but the labor used to apply the paint not only costs more than the paint itself, but over the course of years may become an expensive maintenance charge if repainting is frequent. When selecting materials, these repainting charges must be considered as well as the first cost of the materials. Greater knowledge about corrosion and its prevention has increased the life of many materials in recent years; the average useful life of steel in 1920 was about 23 years. In 1940, this average useful life had risen to about 35 years. During the same period, the life of power wood poles had been lengthened from 25 to about 40 years. Similar improvements have been made in nearly every material used in modern engineering. When we aim for half a century of life for installed power systems, boiler plants, and industrial equipment, selection of material becomes very important, and it is often cheaper to install more expensive material that would need less repainting than a cheaper material which has to be repainted for years. When selecting materials, the small parts must be considered as well as the big ones. Rivets and bolts must be as strong and enduring as the members of tower or tank. These small items frequently produce the first failures in a system.

Selection of Metal

Metals are subject to destruction from chemical and electrolytic attacks. Care must therefore be exercised in selecting the proper metal for the particular corrosive agent which will form the environment surrounding the metal. A wide range of inexpensive resistant metals is available. Industry has developed new

Table I. Shows loss in weight of different alloys and metals in grams (after cleaning) after they have been exposed to various atmospheres for 10 years (4)

Metal	LOSS OF WEIGHT IN 10 YEARS—GRAMS							Metal Analysis Percent
	INDUSTRIAL		OCEAN-SALT			RURAL		
	Altoona Pa.	New York N. Y.	Sandy Hook	Key West	La Jolla Calif.	Pa. State College	Phoenix Ariz.	
A. Com'l Copper, tough	−14.7	−14.9	− 8.2	− 6.3	−16.6	− 7.2	−1.7	99.9 + Cu, 0.026 O_2
B. Com'l Copper, phosphorized	−14.4	−14.5	− 8.5	− 6.6	−14.0	− 6.6	−1.4	99.9 + Cu, 0.007 P
C. Silicon-Mang.-Copper	−16.4	−18.6	−13.7	−12.1	−21.7	− 5.7	−2.1	96 Cu, 3 Si, 1 Mn
D. Tin Bronze	−18.2	−22.5	−15.6	− 9.7	−25.6	− 4.1	−2.0	92 Cu, 8 Sn
E. Aluminum Bronze	−18.7	−18.7	−15.1	− 3.6	− 2.2	− 2.2	−0.7	92 Cu, 8 Al
F. Com'l Aluminum	− 1.9	− 3.0	− 0.2	− 0.3	− 2.7	− 0.1	−0.01	99 + Al
G. Alum. Manganese Alloy	− 5.9	− 3.9	− 0.5	− 0.3	− 2.2	− 0.1	−0.01	99 + Al, 1 Mn
H. Manganese Bronze	−70.1	−59.4	−30.0	−15.6	−18.0	− 3.6	−1.3	66.4 Cu, 19.3 Zn 5.88 Al, 4.6 Fe, 3.8 Mn
I. Brass, Red, 85% Cu	−27.0	−27.4	−14.6	− 5.8	− 7.4	− 9.2	−1.4	85 Cu, 15 Zn
J. Brass, Yellow, 70% Cu	−30.4	−26.3	−12.0	− 4.3	− 3.5	− 4.7	−1.4	70 Cu, 30 Zn
K. Duraluminum	− 5.2	− 4.5	− 0.3	− 0.6	− 6.0	− 0.2	−0.04	4 Cu, 0.5 Mn, 0.5 Mg 95 Al
L. Alum.-Magnes.-Sil. Alloy	− 2.3	− 2.7	− 0.4	− 0.2	− 2.4	−0.16	−0.02	98 Al, 0.5 Mg, 1 Si
M. Chemical Lead	−10.8	− 6.7	....	− 8.8	− 6.5	− 7.6	−3.8	99.9 Pb, 0.06 Cu
N. Com'l Zinc (Western)	−48.6	−49.8	−14.1	− 5.2	−17.4	−10.2	−2.1	Prime Western Grade
O. Commercial Tin	−15.6	−12.2	....	−21.7	−23.5	− 4.5	−3.3	99.85 + Sn
P. Copper-Ni-Zn Alloy	−26.8	−22.2	−13.0	− 3.7	− 3.8	− 4.3	−1.10	75 Cu, 20 Ni, 5 Zn
Q. Nickel-Copper Alloy	−17.3	−16.6	− 7.9	− 1.9	− 2.2	− 1.5	−0.49	70 Ni, 30 Cu
R. Commercial Nickel	−47.9	−40.5	− 9.3	− 1.5	− 1.4	− 2.0	−0.4	99 + Ni

materials and treatments as a result of technical research during and since World War II, and the whole question of materials is in a state of flux. The debate is now on; whether new types of paints are superior to galvanizing; whether plastics are better than metals for cable sheathing and underground piping; whether plastic will replace insulators made of porcelain or glass and whether it will replace other materials for wire coverings; how much copper and steel will aluminum displace for cables, transmission towers, tanks, line hardware; how much life and cost will be gained by covering metals with coatings of nobler metals, copper, stainless steel, aluminum, zinc. For what voltages will treated wood poles replace steel towers? And so on throughout the whole range of materials in the industrial and power field. Up to now, little has been done to prevent corrosion by improving carbon or low alloy steels. (1) Many high alloy steels have been developed which resist corrosion but they are expensive. Much more has been done to control corrosion by using improved protective coatings for the metal and by removing the active cause of the trouble or using inhibitors or neutralizers.

Resistant alloys, nobler metals, should be used in critical positions where replacement is costly or difficult. Where the alloy or metal and the quantity needed are too expensive, costs can be reduced and strengths maintained by using clad steel (not just plated metal), such as *copperclad* or *copperweld*, *niclad* (nickel), *alclad* (aluminum coated), *stainless-clad* and other types of coated steel sheets, rods, etc. Some metals become or can be made self-inhibiting, such as stainless steel, copper, aluminum, etc. These metals

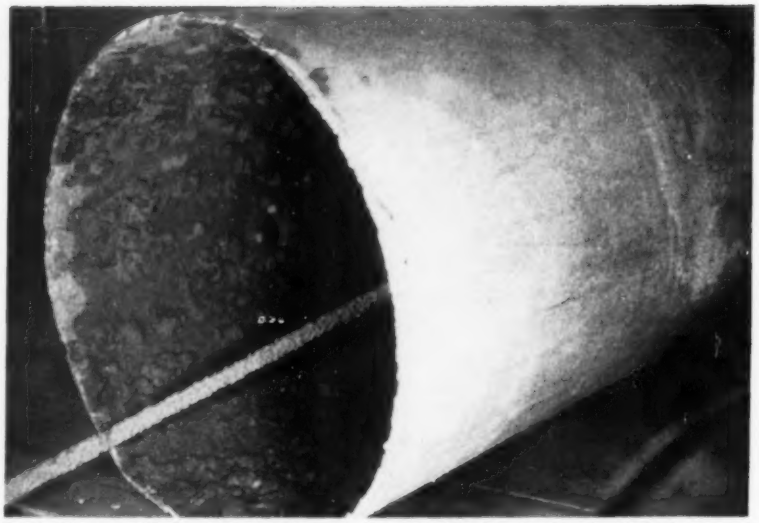


Fig. 1. Cut away half of vertical electric hot water heater tank, showing bright galvanized exterior and badly corroded interior surfaces, together with the badly eaten anodic magnesium protective rod

quickly form oxide films that repel further attack.

Non-ferrous metals also corrode by oxidation when exposed to the average atmosphere, and the character of the atmosphere is very important. Industrial acid atmospheres and coastal salt air are generally more corrosive than clean rural atmospheres. In fact, corrosion hardly occurs in dry desert airs as can be witnessed by the metal objects found in Egyptian tombs after several thousand years of exposure.

The American Society for Testing Materials published some very interesting data (2) on the loss of metal and tensile strength for commercial non-ferrous metals and alloys exposed to different kinds of atmosphere for about ten years. Tables I and II are condensed summaries of the many tabulations presented in this symposium. Table II is particularly interesting as it shows the loss in strength of a beam or cable or bolt made from these different metals that might occur after ten years of exposure. Obviously metals and alloys that are shown to be unsafe after 40 years in a particular location should not be used there.

Life of Various Metals

The installation costs of power transmission equipment are high, so that many studies have been undertaken to make the life of this equipment as long as possible. The fungicidal treatment of fiber products, poles, cross arms ties, timbers and rope, etc. is now standard practice and has done much to extend the life of these items towards the goal of 40

Table II. Showing the loss in tensile strength of various non-ferrous metals and alloys after they have been exposed to various atmospheres for 10 years (4)

Commercial name of metal or alloy	Average Tensile Psi	PERCENT LOSS IN TENSILE STRENGTH						
		Type of Atmosphere and Location						
		INDUSTRIAL		OCEAN-SALT			RURAL	
		Altoona Pa.	New York N. Y.	Sandy Hook	Key West	La Jolla Calif.	Pa. State College	Phoenix Ariz.
A. Com'l Copper, tough	32,000	−10.9	−10.3	− 7.6	− 6.1	−13.9	− 8.4	− 5.2
B. Com'l Copper, phosphorized	34,000	− 3.6	− 4.0	− 1.1	+ 0.9	− 5.3	− 0.7	+ 1.9
C. Silicon-Mang.-Copper	56,000	− 8.6	− 8.8	− 6.2	− 3.8	− 6.0	− 2.7	− 2.5
D. Tin Bronze	55,000	− 8.1	− 8.8	− 5.9	− 4.7	− 8.3	− 4.0	− 1.5
E. Aluminum Bronze	72,000	− 5.1	− 7.4	− 2.7	− 0.7	+ 0.4	+ 0.2	+ 0.2
F. Com'l Aluminum	16,000	− 4.7	− 3.4	− 0.1	+ 1.4	−11.5	+ 3.2	+ 1.3
G. Alum. Manganese Alloy	20,000	− 9.6	− 5.3	− 2.1	+ 0.4	− 6.7	+ 0.6	+ 1.9
H. Manganese Bronze	100,000	−54.2	−53.7	−19.9	−13.9	−23.9	+ 1.3	− 4.0
I. Brass, Red, 85% Cu	39,000	− 6.7	− 4.4	− 1.2	+ 2.0	−00.1	− 0.4	− 3.2
J. Brass, Yellow, 70% Cu	43,000	−29.6	−26.8	−10.4	− 0.2	− 6.3	− 1.4	+ 1.6
K. Duraluminum	60,000	−13.2	−11.5	− 8.3	− 2.3	−49.0	+ 3.0	+ 2.7
L. Alum.-Magnes.-Sil. Alloy	40,000	− 9.5	− 6.2	− 2.9	+ 2.9	−22.1	+ 4.8	+ 8.7
M. Chemical Lead	2,350	− 8.2	− 8.4	−10.6	− 8.8	− 7.3	− 7.7	− 6.6
N. Com'l Zinc (Western)	27,000	−24.4	−22.9	− 9.4	− 4.7	−13.5	− 8.7	− 4.7
O. Commercial Tin	2,900	−25.4	−22.1	−28.0	−26.2	−35.8	−19.2	−22.4
P. Copper-Ni-Zn Alloy	51,000	−11.4	−10.1	− 7.1	− 4.8	− 4.9	− 4.5	− 3.3
Q. Nickel-Copper Alloy	78,000	− 3.4	− 4.2	− 2.8	+ 0.6	+ 0.2	− 0.3	− 0.3
R. Commercial Nickel	70,000	− 9.7	− 8.4	− 0.4	+ 1.9	+22.0	+ 2.7	+ 1.6

Table III. Expected life of bolts (No Coating) [2]

Type of Metal	Yield Strength	Years of Life ⅜" Bolt	Bolt Diameter Required for 40 year Life
Mild Steel	33,000	7.0	1¼ in.
Copper bearing Steel	33,000	10.1	1 in.
Low alloy steel Corr. Resist.	47,000	35.7	⅝ in.
Duraluminum, 17-ST	40,000	153.0	⅞ in.
Silicon Bronze	45,000	797	⅞ in.
Stainless Steel 13 Chrome	35,000	1,580	½ in.
Stainless Steel 18–8	30,000	19,100	½ in.

[2] E. W. Oesterreich, Duquesne Light Company, E. E. I. Reports.

Table V. Expected life of hot dip galv. coating

Thickness of Coating		Years to First Show of Rust		Expected Life-Years	
Oz. per Sq. Ft.	Thickness Inches	Min.	Max.	First Perforation Average (a)	Life
2.5	0.0042	4.0	8.5	20.0*	16
2.0	0.00337	3.5	5.8	18.0*	12.8
1.5	0.00252	3.3	4.3	17.2	9.6
1.25	0.00210	2.5	3.3	17.0	8.0
0.75	0.00126	2.0	2.3	16.2	4.8
0	0	—	—	5.6	4.0*

* Estimated.
(a) Time until half of the specimens became perforated.
[3] E. W. Oesterreich, Duquesne Light Company, E. E. I. Reports.

Table IV. Shows years of useful life expectancy

Metal or Alloy	Years
18–8 chrome nickel steel (passive)	16,000
8–20 nichrome	320
Lead	180
Copper	170
Nickel	120
70–30 yellow brass	80
Zinc	70
Copper-chrome (low alloy) steel	16
Wrought iron (Si = 0.3)	13
Copper bearing steel	12
Mild steel (structural grade)	10
Wrought iron (Si = 0.09)	6

Table VI. Shows expected life of metal coatings [3]

Thickness of Coating		Years of Expected Life			
Oz. per Sq. Ft.	Thickness Inches	Zinc	Aluminum	Lead	Copper
2.5	0.0042	16.0	57.4	46.8	3.02
2.0	0.0037	12.8	46.1	37.6	24.4
1.5	0.00252	9.6	34.5	28.1	18.2
1.25	0.00210	8.0	28.7	23.4	15.2
0.75	0.00126	4.8	17.2	14.0	9.1

[3] E. W. Oesterreich, Duquesne Light Company, E. E. I. Reports.

Table VII. List of inhibitors which will prevent corrosion between various metals and their environments

Metal	Environment	Inhibitor
Aluminum	Phosphoric acid	Alkali chromates
Aluminum	Phosphoric acid, 20%	0.5% sodium chromate
Aluminum	Antifreeze alcohol	Sodium nitrite, sodium molybdate
Aluminum	Carbon tetrachloride	0.05% formamide
Aluminum	Chlorine water	Sodium silicate
Aluminum	Commercial ethyl alcohol	0.03% alkali carbonates, lactates acetates or borates
Aluminum	Ethylene glycol	Alkali borates and phosphates
Aluminum	Methyl alcohol	Sodium chlorate plus sodium nitrite
Aluminum	Sodium hydroxide, 1%	Alkali silicates
Aluminum	Sodium hydroxide, 1%	3–4% potassium permanganate
Aluminum	Sodium chloride 3.5%	1% sodium chromate
Aluminum	Sodium carbonate, 10%	0.05% sodium silicate
Copper and brass	Ethylene glycol	Alkali borates and phosphates
Copper and brass	Polyhydric alcohol anti-freeze	0.4–1.6% sodium phosphate plus 0.3–0.6 sodium silicate + 0.2–0.6% sodium mercaptobenzothiazole
Copper and brass	Water—alcohol	0.25% benzoic acid or 0.25% sodium benzoate at a pH of 7.5–10
Magnesium	Water	1% potassium dichromate
Magnesium	Alcohol, glycerine, glycols	Alkaline metal sulphides
Monel	Sodium chloride, 0.1%	0.1% sodium nitrite
Monel	Tap water	0.1% sodium nitrite
Steel	Ethylene glycol	Alkali borates and phosphates
Steel	Ethyl alcohol, 70%	0.15% ammonium carbonate + 1% ammonium hydroxide
Steel	Sodium chloride, 0.05%	0.2% sodium nitrite
Steel	Water	Benzoic acid
Steel	Water, saturated hydrocarbons	Sodium nitrite
Tin plate	Carbon tetrachloride	2% mesityl oxide, 0.001% diphenylamine
Tin plate	Sodium chloride, 0.05%	0.2% sodium nitrite

References

[1] Corrosion, Causes and Prevention, Dr. Frank N. Speller, McGraw-Hill Book Co., p. 5.
[2] Report of Subcommittee VI, Appendix B, Pittsburgh Symposium ASTM, Feb. 1946.
[3] [4] Taken from Report of Subcommittee VI, B-3, Symposium ASTM, Feb. 1946.

years. The paints used to coat metal structures have also been improved greatly in recent years and serve to increase the life of the materials.

Line hardware is now getting its share of attention. Under the direction of the Edison Electric Institute, many interesting studies have been made on metals used in transmission and distribution. E. W. Oesterreich, of the Duquesne Light Company, has done some excellent work on the life of over head line hardware. Tables, III, IV, V, and VI show some of these results. They show why the ultimate life of a material should be considered and not just its first cost. Suppose a low corrosion resistant alloy of steel has a life expectancy which is double that of mild structural steel; the installation costs, material, and labor for the low alloy would hardly be twice that of the mild steel on most power transmission projects and so it would be cheaper in the long run to put in the low corrosion alloy. Aluminum is now being suggested for members of towers and similar structures for longevity and low ultimate cost.

Steel bolts are never used outside in the power industry without a good coating. EEI specifications require a hot dipped zinc coating of not less than 1 ounce per square ft. Table V shows the effect of the thickness of the zinc coating on the life of 22 gage sheet. The useful life varies from four years without coating to 16 years with 2.5 ounces per sq ft thickness of hot dipped zinc galvanizing.

Table VI compares the life expectancy of equally thick coatings of aluminum, lead, and copper with zinc. These clad metals are now commercially available. Steel clad with two ounces of aluminum per sq ft of surface would give a life expectancy of 40 years against only 12.8 years with zinc. Copper weld or copper clad materials are becoming more popular, with double the life of zinc for the same thicknesses.

Much work has been done by many people in the field of corrosion resistance and their findings are available in the literature of the engineering societies. But the producers of various metals, alloys, coatings, as well as government and public agencies have made available to engineers, at practically no cost, sufficient data to enable operating and design personnel to make accurate decisions about prolonging the life of their metallic structures. An example of the very useful information that is available is the comprehensive table of corrosion inhibitors that can be used with various metals to reduce corrosion, compiled by Maxey Brooke, in the Corrosion Forum of *Chemical Engineering*, September 1952. A few examples are shown in Table VII for some of the more common metals and materials in an average power or industrial plant.

This article will be concluded in a future issue of POWER ENGINEERING with a discussion of plated coatings.

Fig. 1. Shows bulldozer pushing heavy fill into position under apron of dam

Fig. 2. Showing the start of drilling vertical holes down through the dam

Repairing Concrete Structures

This article describes how cavities below small power station dam were filled and broken surfaces repaired. Same means can be used for building foundations and other structures

By H. NYE JOSLEYN

REPAIRING AN OLD concrete structure is often more difficult than building a new one. Good illustration of this was the rebuilding of the powerhouse dam of the Iowa-Illinois Gas & Electric Co. at Fort Dodge, Iowa. The job called for both experience and ingenuity. Located on the upper Des Moines River, this dam had pockets washed out below the foundations from 6 in. to 2 ft, and the surface of the piers was badly broken and eroded.

Engineers of the utility company decided to do the job in three stages. The first step was to fill the washed-out holes under the downstream side as far as possible under the apron. Then the foundation was anchored. Finally the top and downstream surfaces were repaired.

Fig. 3. Two air-powered mixers for preparing grout

Solid blocks of old concrete and large stones were trucked to the stream bed below the dam and pushed into position by bulldozers. Front end loaders were used to put coarse gravel in the spaces between the heavy fill. First runways had to be built for the machines to reach some of the deeper pockets.

Consolidating the Fill

The next job was to force grout into the voids under the dam. To do this, holes were drilled at 4 ft intervals vertically from top to bottom of the structure. To prevent further cracking and breaking of the main body and surface, the 2½ in. holes were first drilled ⅞ in. diameter and then enlarged. Then a special grout was pumped through 1¼ in. pipes lowered down the 2½ in. holes.

Starting at the west bank, the grout was intruded progressively underneath the structure through the 1¼ in. pipes with just enough pressure to fill the holes under the structure. Thoroughness of penetration was shown by the appearance of mortar at cracks and other openings. The 1¼ in. pipes were removed immediately all the grout had been pumped.

After a minimum of 48 hours for hardening, the 2½ in. holes were redrilled right through the new mortar. Again, using the 1¼ in. pipes, more grout was pumped through the new mortar, this time at a pressure of 100 psi. When this second batch of grout had hardened, the process was repeated with another batch at a pumping pressure of 125 psi. To complete the last operation, a 1 in. reinforcing rod the length of each hole was grouted in.

Grout Mixer

The grout mixture for the intrusion consisted of one bag of Portland cement; one bag of Alfesil; one bag of Intrusion-Aid; 5 cu ft of sand and about 15 gal of water. The Portland cement conformed to Federal Spec SS-C-192 Type 1-A. One bag weighed 94 lb.

The Alfesil, a filler, used in the intrusion mixture, is made from compounds of silicon, aluminum and iron, which combined with the lime liberated during the hydration of Portland cement. This filler causes

Fig. 4. A cement pump doing duty as a water pump

Fig. 5. Front-end loader used in filling voids between heavy fill under dam

Fig. 6. Chipping concrete away from the cracked and spalled pier surfaces

the mixture to develop great strength when it has set for a long time, and it prevents agglomeration of cement particles. A bag of Alfesil weighs 75 lb.

The Intrusion-Aid gives the grout colloidal suspension properties, which not only makes pumping easier, but helps the mixture flow through all cracks and spaces in the fill. It prevents settling and early shrinkage of the mortar. One bag weighs 2½ lb.

The mortar was thoroughly stirred in dual mechanical mixers for about 1½ minutes until it had the consistency of thick cream. The grout was kept agitated until it was pumped under the foundation.

The grout was fed by gravity through molasses valves to a single cylinder double acting pump. From the pump it was discharged through a 1 in. rubber hose through the 1¼ in. pipes. The pump had rubber faced valves and rubber pistons. A by-pass on the pump allowed the valves on the hose line to be closed and would have provided protection if the lines had become clogged.

Test cylinders of the hardened grout showed between 3,000 and 4,000 psi in 7 days and 4,000 to 7,000 psi after one year.

The following method of repairing the cracked and spalled concrete surfaces of the powerhouse dam were also used on the piers of a small hydro-electric dam a few miles upstream.

Repairing Damaged Surfaces

Old concrete was first chipped off the damaged surfaces to insure a minimum thickness of 6 in. for the new material to be added. Then grids of ½ in. reinforcing rods at 2 ft intervals were anchored over the areas needing repair, and wooden forms built round them to restore the original dimensions. The forms were then filled with cracked limestone, which was tamped and rodded during placing to make it as compact as possible.

Holes were drilled at 1½ ft spacing throughout the forms to take the ¾ in. pipe through which the grout was to be pumped. Beginning with the last row of holes, the grout was pumped into each one until it appeared at the nearest adjacent openings. As the ¾ in. pipe was removed from each opening, the hole was stopped with a blunt wooden plug. This procedure was then repeated for the next row of holes and so on until the grout appeared at the top of the forms.

To allow the grout to be consolidated, but at the same time let top water and air escape, a special lid was secured over the top of the form. It consisted of a sheet of muslin next to the top grout, backed by a mesh of wire window screen under a reinforcing of wire lath. The metal lath was fastened to the underside of the wooden top form which was perforated with enough drilled holes to allow excess water and air to be forced out under a grout pressure of 50 psi. By covering the mix this way there was no danger of grout escaping with excess water and air.

The grout mixture used for surface repair was richer than the grout used for filling under the dams. It consisted of two bags of cement, one bag of Alfesil, one of Intrusion-Aid, and 3 cu ft of sand.

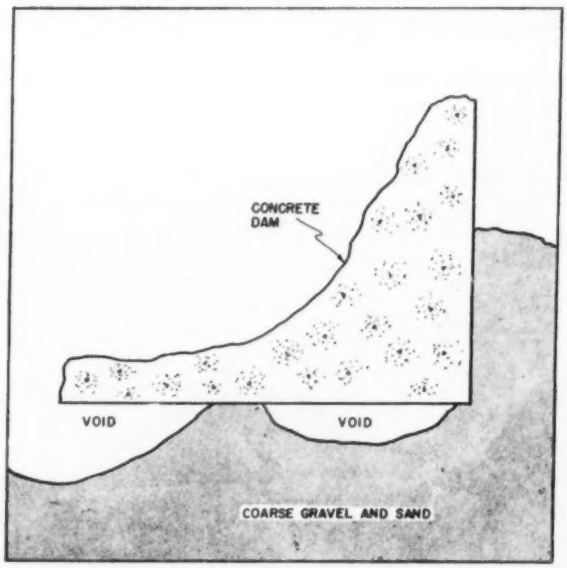


Fig. 7. Section through dam showing voids beneath foundation before filling

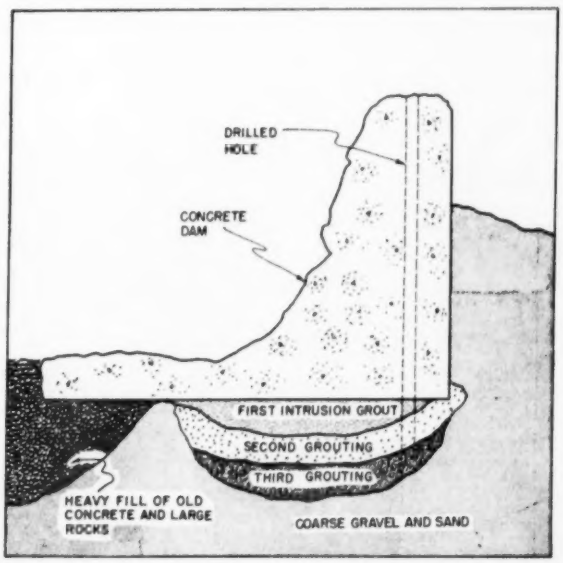


Fig. 8. Showing how voids are filled and grout consolidated in three stages

Water Can Carry Your Coal and Ash

A stream of water is often cheapest and best way to move coal and ashes. Author gives examples of hydraulic conveying in small power plants, then discusses long distance piping of coal

By **WILBUR G. HUDSON,** Consulting Engineer

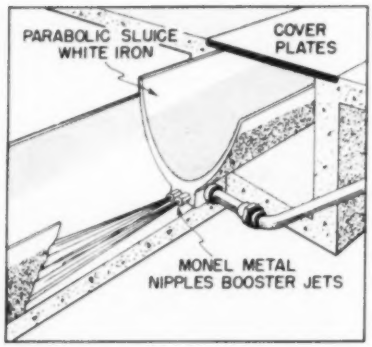


Fig. 3. Shows stepped sluice with booster nozzles

THE FOLLOWING EXAMPLES describe some applications of hydraulic conveying in modern small plants. Figure 2 shows a small steam plant. It had a standard coal handling layout from track hopper to bunker, and the screw conveyor over the bunker had a capacity of 20 tph.

Building a Coal Storage Pile

When the plant had been operating for some time, carload deliveries increased beyond the bunker capacity so that outside ground storage had to be provided for the surplus. A 500 gpm fire pump was available, so a 6 in. sheet steel pipe was rigged up on X supports and water was jetted into the end adjacent to the elevator head. This stream flushed the coal at about 10 tph. A bypass with an adjustable gate was provided in the chute, so when a car was dumped, half the coal went to the screw conveyor, the rest to ground storage. The investment was $200 — about 10 per cent of the cost of a mechanical conveyor.

Here is another installation in which hydraulic conveying worked out well.

Figure 1 shows the long shipping bin of a coal preparation plant which loads several sizes of washed coal into cars on adjacent sidings. Undersized coal is screened out, to be reclassified and returned to the bins. From the screens, it falls to a 24 in. open horizontal sluice which extends the length of the structure. The sluice is stepped at 48 ft intervals to accommodate booster jets as shown in Fig. 3. The screenings are carried along the sluice by the water jets and the mixture of water and screenings discharges to the sump boot of a perforated bucket elevator which dewaters the coal as it is lifted to the reclassifiers. The water from the sump is sent back to rejoin the coal washing water. The volume of screenings varies widely and the booster jet water can be varied accordingly.

This job might be done by tandem screw conveyors, drag chain conveyor, or belt conveyor; but the advantages of the hydraulic sluice are simplicity, low investment and maintenance, no moving parts, and no risk of injury to the men loading and moving the cars.

Ash Removal

Figure 5 shows the ash removal arrangement at a municipal water plant in New Jersey. The ashes, with a lot of clinker, dribble continuously over the rear ends of chain grate stokers, into a 12 x 24 in. concrete trench. About 7 tons collect in 24 hours. A 600 gpm pump is throttled to maintain a stream about 3 in. deep along the floor of the sluiceway; this stream floats the ashes to the sump. The water drains to a reservoir alongside, from which it is recirculated. The plant crane comes around once a day to load the trucks.

Ash Distribution

A plant had to dispose of 20 tons of ashes every 24 hours. A depressed area about 500 ft from the plant was available. Any scattering of dust was objectionable. Ample water was available from a neighboring stream, but pollution of the stream was prohibited.

A pressure of 100 psi was used to flush the ashes from the pit (Fig. 4), to a sluice in which booster jets, spaced about 18 ft, moved the mixture of ashes and water to the disposal area. No dust was scattered and the disposal area had sandy soil through which the water filtered away.

With sloping floor ashpits, a nozzle using 175 gpm flushed the pits at nearly one ton per minute. Each booster nozzle required 225 gpm so the total water volume was 1525 gpm. The ashpits had a capacity of 5

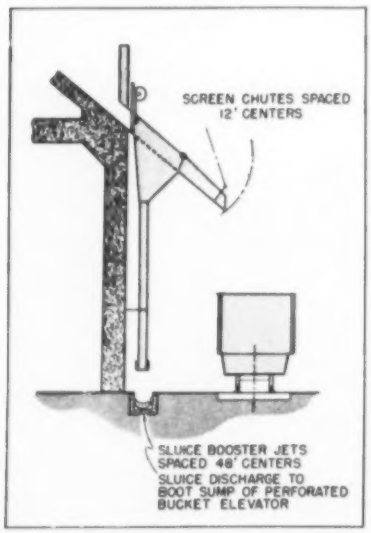

SCREEN CHUTES SPACED 12' CENTERS
SLUICE BOOSTER JETS SPACED 48' CENTERS
SLUICE DISCHARGE TO BOOT SUMP OF PERFORATED BUCKET ELEVATOR

Fig. 1. (left) Water jets carry screenings from several coal loading chutes along the sluice to reclassifiers

Fig. 2. (below) Making coal storage pile by passing 10 tons per hour through a 6 in. sheet steel pipe

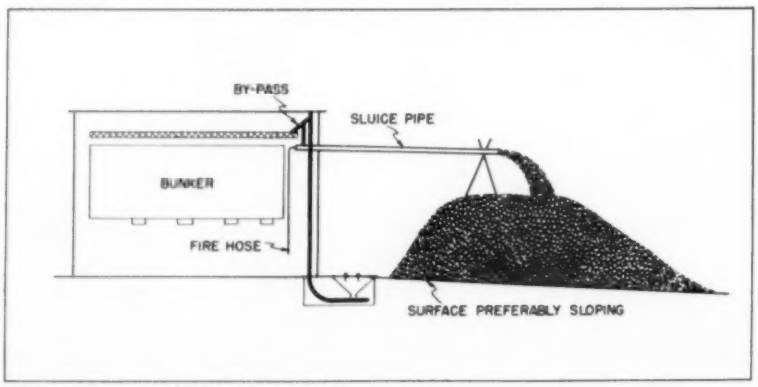


Table 1. Shows quantity of water needed to pump coal through a pipeline for several coal-water ratios

Coal t.p.h.	Coal per cent	Coal-water mixture: Gals per hr.	Gals per min.	Cu. ft. per min.	Water gals per day
208	25	186,326	3,105	415	3,589,000
	30	153,275	2,555	341	2,791,000
	35	129,168	2,153	288	2,216,000
	40	111,530	1,859	249	1,792,000
292	25	261,574	4,360	583	5,038,000
	30	215,175	3,586	479	3,918,000
	35	181,332	3,022	404	3,111,000
	40	156,570	2,610	349	2,515,000

or 6 tons each, so three 15 minute runs handled the 24 hour accumulation of ashes. The sluice was a concrete trench about 18 in. deep. The operating labor cost was as low as 16¢ per ton. Many large steam plants use this type of ash disposal equipment.

Long Distance Coal Pipeline

In the above examples materials were carried only a short distance; future hydraulic conveying may be used to carry coal long distances. The Pittsburgh Consolidation Coal Company is constructing a full-scale pipeline near Cadiz, Ohio, which has a 12 in. diam pipe 17,000 ft long. Finely ground coal will be mixed with water and pumped continuously.

Mr. R. W. Dougherty of the U. S. Bureau of Mines has made an extensive survey of the possibilities of hydraulic transportation of coal. He concludes that large tonnages of coal may be transported economically in pipelines, but pumps, either centrifugal or reciprocating, will require much development before they are suitable for this purpose.

Mr. Dougherty gives data for handling coal in capacities ranging from 208 tph to 1500 tph, and with mixtures ranging from 25 per cent to 40 per cent of coal to water by weight. We will limit our discussion to capacities between 200 and 300 tons per hour. The pump manufacturers do not agree about the best proportion of coal to water; opinions vary from 25–40 per cent. A safe velocity is 10 to 12 ft per second. Parallel water-return lines are provided to save water and cool the coal pumps. A 10 per cent loss of water at the discharge end may be assumed. Table I gives the coal-water quantities for 208 tph and 292 tph, and for mixtures from 25 to 50 per cent of coal to water by weight. Table II shows Mr. Dougherty's preliminary estimate of operating costs for a 100-mile pipeline running 360 days per year, with a capacity of 5,000 and 7,000 tons per 24 hour day. Table III shows the total investment cost.

The chief competitor of the long distance pipeline is likely to be the belt conveyor. Recent improvements have made conveyor belts good for tensions up to 3,000 pounds per inch of belt width, so that single units of 2 miles or more are available. For an installation 100 miles long with a capacity of 300 tph, we could specify 50 tandem 30 in. conveyors at 400 fpm belt speed. Each unit would require 240 hp or a total of 12,000 hp for the line. It would be controlled from a central station by micro wave radio, and the only line personnel required would be inspection and safety patrols. Estimated cost for the

(*Continued on page 106*)

Table 2 Estimated Costs for a 100-mile Pipeline

Coal—tons per day	5000	7000
—tons per hour	206	292
—per cent by weight	30	30
—size	1½ x 0	1½ x 0
Coal pipe dia.	12	14
Water return line dia.	10	12
Pumping stations	11	13
Total hp. all stations	13,387	20,319
kw hr. per day	239,680	363,700
Make-up water, gal/day	279,000	392,000
Personnel per station	10	10
Total labor personnel	110	130
Daily operating costs		
Direct labor	1,254	1,482
Supervision—15%	188	222
Maint. material & supplies		
Pipeline—1%	186	204
Pumping stations—3%	159	241
Depreciation—9%	2,518	2,989
Taxes—1½%	420	498
Interest—3%	839	996
Miscellaneous overhead—4%	1,119	1,328
Electric power, $0.012/kw. hr.	2,876	4,365
Water $0.10/1,000	28	39
Total	9,587	12,364
Cost per ton—100 miles	$1.91	1.77

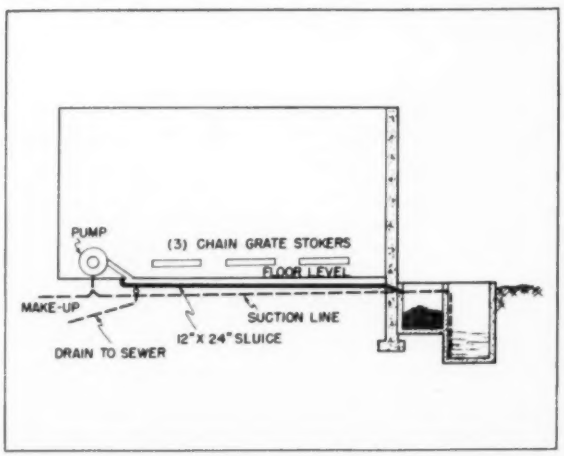
TABLE 3

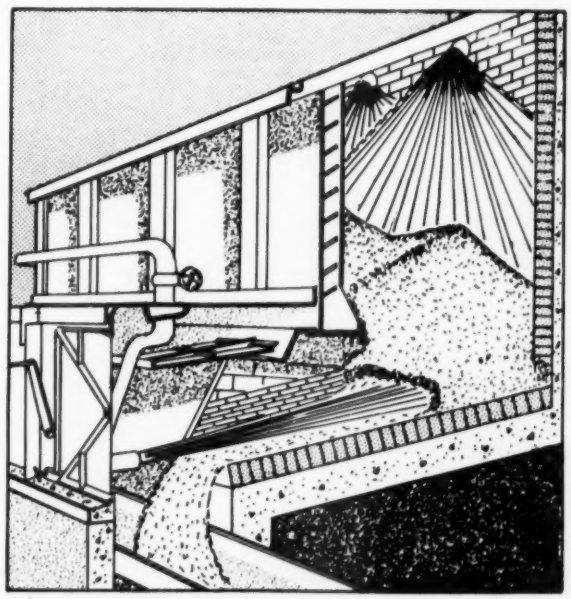
Estimated Construction Cost *	
For 5000 tons a day	$10,071,000
For 7000 tons a day	$11,955,000

* Includes labor, materials, right-of-way, station sites, etc.

Fig. 4. (right) Hydraulic ash-disposal. Booster jets move ashes along sluice

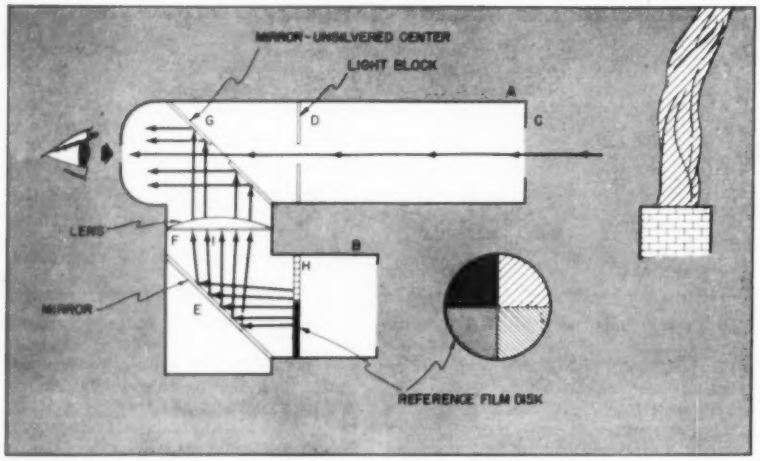
Fig. 5. (below) New Jersey plant using an ash sluice with recirculated water





The Smokescope

An instrument for estimating smoke densities



GROWING public insistence on smoke abatement, and stricter smoke control laws demand more accurate methods of measuring smoke densities than have been available so far. The usual method of measuring stack smoke has been to compare it with the shaded standards of a Ringleman chart, on which each shaded area corresponds to a particular smoke density. The chart is set up 50 ft from the observer in line with the smoke, which is then matched with one of the chart's shaded areas.

Although the Ringleman chart has been useful, it is influenced too much by its surroundings to give consistent results. For example, the same smoke will give one result on a bright day and another on a dull day; it will look different against different backgrounds; and if the light that shines on the chart differs from the light at the stack the readings will vary.

These limitations have been recognized for some time, and several improvements have been devised. One uses a small glass tube through which the smoke can be seen and compared with a standard smoked glass. Another compares the smoke with photographic film which has been darkened to standard smoke density. In spite of these improvements, they are still inaccurate because the light at the observer's position is usually different from that at the stack, and also he has to refocus his eye when looking from stack to reference.

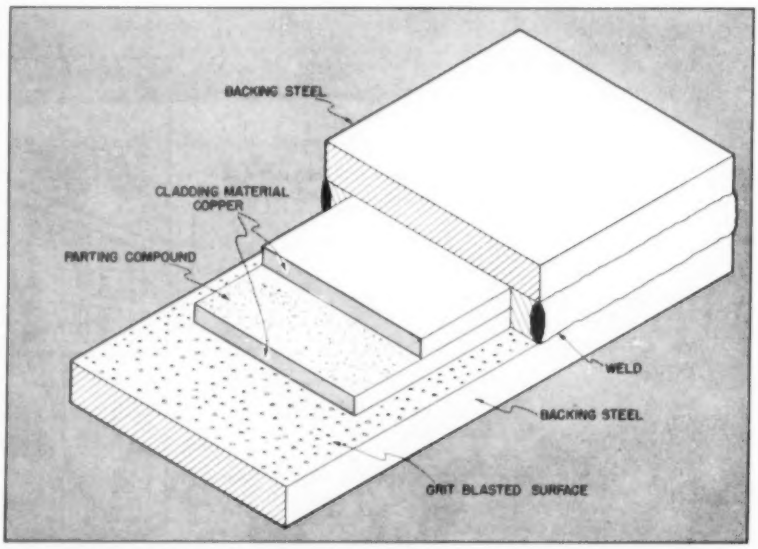
An instrument has been developed in the Mine Safety Appliance Research Laboratory which eliminates these errors. This instrument, called the Smokescope, was described by John P. Strange, Principal Physicist, Mine Safety Appliances Co., in ASME paper No. 53-S-3, presented at the Spring Meeting.

The smoke is seen through the apertures C, D, and the unsilvered center section of mirror G. Light from the stack is transmitted through the reference film disk H in barrel B to the front surface mirror E. By means of this mirror and lens F, an image of the reference film is placed upon the image mirror G, where it may be compared with the smoke seen through the apertures. The reference film disk is set at the focal point of the lens so the eye sees the image of the disk at infinity, and so does not have to change its focus when comparing the stack smoke with the disk. The reference densities corresponding to the four Ringleman numbers appear on the image mirror surrounding the aperture. To prevent the center part of the disk's image being reflected off the unsilvered center of the mirror G, a small round light block I is placed in the center of the lens.

Metal-Clad Metal

DISSIMILAR METALS are bonded together to combine the properties of both; for example, copper clad steel may be used to make a tank combining the corrosion resistance of copper with the mechanical strength of steel. Since most of the metals used for cladding are rarer than steel, the combination saves money and strategic metals. Steel plates are now clad with copper, stainless steel, nickel and other metals, and the makers of clad steels look forward to extending their range of products with such metals as tantalum, titanium, zirconium, etc.

Clad steel can be drawn, bent, twisted, flame cut, sheared, punched and formed like a single metal. The diagram shows how it is made. Two slabs of steel form the outer layers; between them are placed two plates of the cladding material separated from each other by a parting compound. The "sandwich" is welded round the edges to prevent the components slipping or separating and to protect the surface of the cladding material during processing operation.



Four-ply pack assembly for making copper-clad steel. After hot rolling, the welded edges are cut off

The whole pack is then heated and rolled on a plate mill. After rolling, the welded edges are trimmed from the pack and the sandwich is separated into two clad steel plates.

Pulverized Coal Developments

Gasifying Pulverized Coal To Meet Germany's Increased Need

NEW PROCESS for gasifying pulverized coal, developed by the Ruhrgas Corp., Essen, is expected to answer the increased demand for coke-oven gas in Germany. Ready for commercial application, its results exceed those of conventional gas producers gasifying coke. This was brought out in a report by Dr. Kurt Traenckner, assistant director of the Ruhrgas Corporation, which was presented by Dr. Wilhelm Gumz, consultant, of Columbus, Ohio, at the annual meeting of ASME in December.

Gas consumption in Germany has increased rapidly during the past 25 years. Since practically no natural gas is available and an insignificant amount of gas is made from residual oils, practically all the gas has to be manufactured from coal. A sharp increase in consumption was made possible by the distribution of coke-oven gas from the two main coal-producing areas, the Ruhr and the Saar districts. A major part of the coke-oven gas produced in the Ruhr (termed "Ruhrgas") is piped by the Ruhrgas Corp. over long distances to industry, as well as to local gas companies.

At present the supply is not sufficient to meet the demand for gas in Germany, the report stated. All the surplus gas from coke-oven plants is disposed of, and an increase in gas production by increasing coke production can hardly be expected, because of the limited supply of coking coal and the lack of a market for more coke. Additional quantities of gas can be produced only by methods which do not require coking coal and do not produce additional lump coke.

Research Begun in 1936

To meet this general situation, Ruhrgas started research activities in 1936. World War II interrupted the work, but it was resumed in 1947.

All the company's research work is pointed toward making producer gas for use as a heating gas, synthesis gas for chemical uses, and high-Btu gas (490 Btu per cubic foot) for pipe-line distribution. Since coke-oven gas is the conventional type of gas distributed by pipe line and the distances are rather short as compared with the United States, a gas approaching the heating value of coke-oven gas is termed a "high-Btu gas," and its distribution is considered economical The conversion of coal into gas requires high efficiencies and large capacity per unit in any case.

The major problem of the German gas industry, according to the report, is to release for pipe-line distribution the large amounts of coke-oven gas which still are used for heating purposes only. To do this it is necessary to gasify low-grade fuels such as high-ash fine coals and dust, which need no preparation except possibly pulverization. Pulverized coal gasification is one way to use bituminous coal of all ranks and types, without dependence on the coking propensity or other coal characteristics.

Vortex-Chamber Producer

By the new process, as described in the report, pulverized coal is gasified in a vortex or cyclone chamber. The high heat release makes it possible to operate the reactor with liquid-slag removal, with preheating of the blast air up to 1100 F. Tapping of the slag in liquid phase is an essential feature of the process, since about 20 per cent of the fuel is recycled in order to maintain adequate carbon concentration in the reactor. Because of the efficient slag removal, the recirculated fuel does not carry much higher ash content than the raw fuel. The process enables a complete consumption of the fuel.

The process, thus far, is very well suited for pulverized lignite, lignite char, and bituminous coal and has been fully tested with these fuels.

Pulverized Coal Without Slagging

POSSIBLE USE of pulverized coal, without slagging, in the boiler of a steam locomotive, has been worked out in a series of trials at Battelle Memorial Institute. Results were presented in a paper by Ralph A. Sherman, assistant director, and Gerald E. Keinath, fuels research engineer, at Battelle, and R. Tom Sawyer, chairman, Technical Committee, Steam Locomotive Research Institute, at the annual meeting of ASME.

In large steam generators where space is not at a particular premium, the large combustion chamber, usually surrounded by a heat-absorbing surface, insures that the ash is cooled sufficiently to avoid slagging and fouling of boiler tubes. But, where space is at a premium, as on a locomotive, pulverized coal has hitherto been unsuccessful because of slagged ash in the firebox and on the flue sheet of the boiler.

For the trials, a design was drawn up for a tubular boiler containing 90 flues of 6-in. diameter which might be applied to a locomotive. The combustion of pulverized coal was carried out in alloy-steel tubes from which the heat was absorbed by an outer, annularly spaced, water-cooled tube. A 5-in. diameter tube in lengths of 10, 15, and 20 ft, was used. A high volatile coal, pulverized to a fineness of 90 per cent through a 200-mesh screen, was fired to this tube at rates of 40 to 160 lb per hr.

The fraction of the heat input in the coal that was absorbed by the water in the outer tube was only 20 to 40 per cent. Thus the particular arrangement used was not practical for a boiler. The interest in the tests lies in the fact that a coal whose ash softening and fluid temperatures were 2160 and 2220 F, respectively, was burned at extremely high rates of heat liberation without difficulty from slagging.

By trials of tubes of successively larger diameter, it is considered probable that an optimum diameter of tube could be found in which, because of higher flame temperatures, higher combustion efficiencies would be obtained and yet slagging could be avoided at relatively high rates of firing.

The rapidly declining interest of the railroads and, consequently, of locomotive builders in the steam locomotive, made it inadvisable for the Steam Locomotive Research Institute to pursue this experimental work to a conclusion. For the present benefit of locomotive designers in other countries and for possible future use in this country, the results of this brief investigation were presented. Also the report may stimulate thought on the development of compact steam generators or of air heaters for closed-cycle gas turbines fired with pulverized coal.

"I'll be all right, Dense — I just thought of what happened to the turbine last time I put you in charge of assembling"

Why Continue to Face High Maintenance and Replacement Costs on

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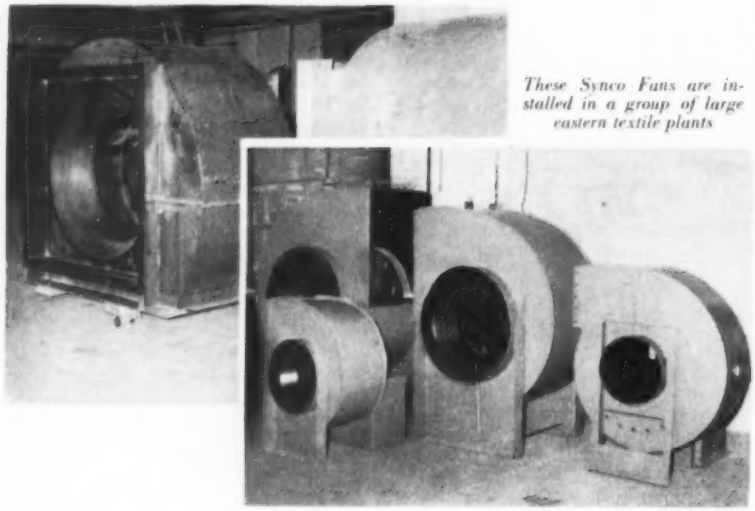

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Amplidyne Regulators for Turbine Generators

General suitability of amplidyne regulators reflected in their wide application on both small and large power systems in the U. S.

AMPLIDYNE VOLTAGE regulators have come into increasing use in the design of excitation systems for large turbine generators in recent years. As described in a paper by W. A. Hunter and M. Temoshok of the General Electric Co. before the AIEE recently, the amplidyne regulator includes a voltage-sensitive circuit composed of static elements, such as transformers, reactors, resistors, capacitors, and metallic rectifiers. These are all reliable, conservatively designed components with long life expectancy. The voltage-sensitive circuit controls the voltage introduced by a rotating amplifier, called an amplidyne, into the shunt field circuit of the self-excited exciter for a large turbine generator.

The regulator controls exciter voltage, by varying the amplidyne voltage to aid or oppose the flow of current through the exciter shunt field, to maintain the generator terminal voltage essentially constant. A minimum excitation limit circuit is employed to guard against reduction of generator excitation below values which will safely avoid loss of synchronism. This limit circuit responds to generator underexcited reactive current, and it can be adjusted to allow larger values of this current at low kilowatt loads than at high kilowatt loads. The limit circuit is composed of static components similar to those used in the voltage-sensitive circuit.

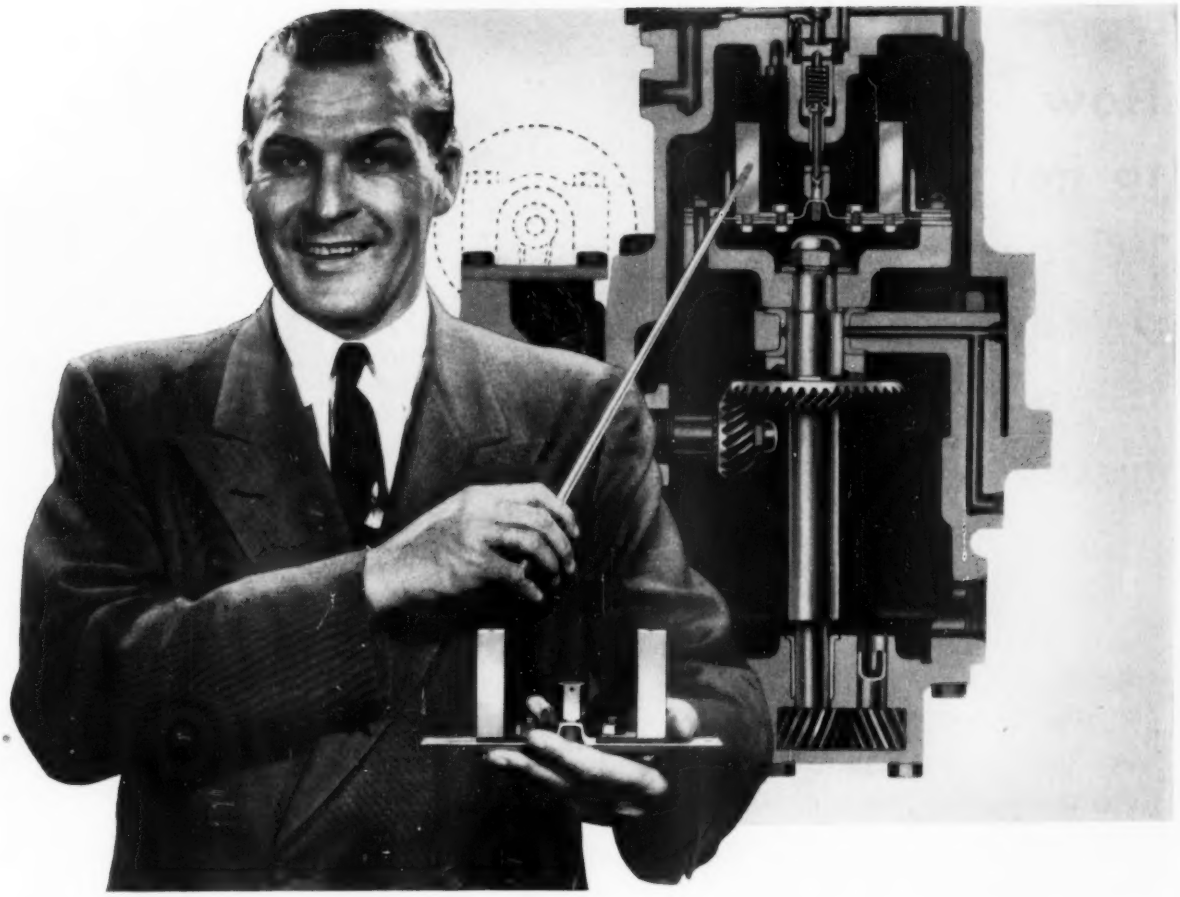
Large Corrective Action

The voltage-sensitive and limit circuits are housed in a floor-mounted enclosure with the auxiliary control equipment. The amplidyne is installed in an associated enclosure, or in a separate location; it is supplied on a base and coupled to an induction-type driving motor. The regulator is designed as a standardized factory engineered and assembled unit requiring a minimum of installation planning and effort.

The amplidyne regulator provides corrective action proportional to variations in generator voltage from the desired value. It is capable of holding voltage within a 1 per cent band, or less, over the full load range of the generator.

The amplidyne regulator provides a relatively large corrective action in terms of amplidyne voltage applied by the regulator in a fraction of a second, which occurs as a result of

(*Continued on page 98*)



"This frictionless sensing element prolongs turbine speed control accuracy"

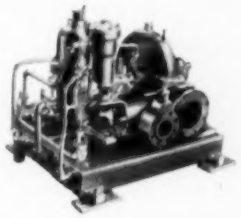
It is a no-travel, frictionless device. It operates in a system which balances forces of oil pressure against centrifugal force. Speed changes reflected in centrifugal force variations are hydraulically transmitted to other elements in the governing system without bearings, knife edges or marked mechanical travel. Simple and maintenance-free, it has no parts to wear, replace or adjust . . . retains precision under the most demanding operating conditions.

Development of this exclusive sensing element to make the Vertical Oil-Relay Governor a precise, trouble-free speed regulator typifies Westinghouse thoroughness in building exceptional reliability into all components of the Type E Turbine line. Over 50 years of expanding engineering and productive facilities, on turbines from 1 hp to the largest made, have achieved manufacturing skills which assure extra-dependability in every Westinghouse prime mover.

Matching the superior design and construction of these turbines is a fully qualified field organization. Application engineers supply experienced counsel and Westinghouse service shops and parts stocks are located coast to coast. Contact your nearest Westinghouse Sales Representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50552

The Type E-125 General-Purpose Turbine

A packaged unit incorporating the Vertical Oil-Relay Governor, and rated 5 to 1500 hp. It can handle all types of loads requiring high-quality speed control.



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Turbines for every industrial use

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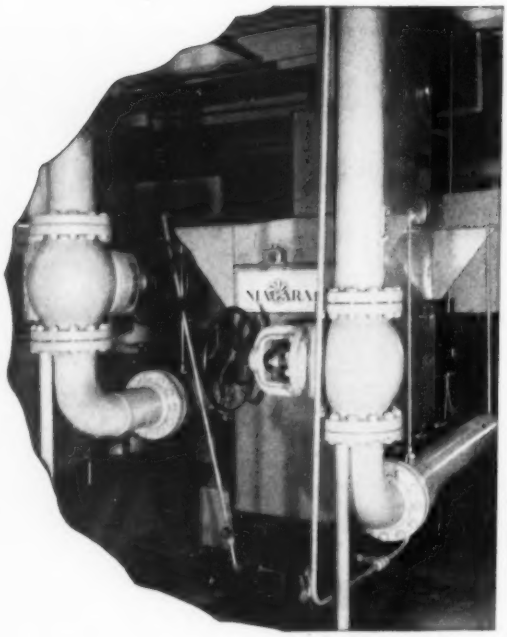
How to get drier or cooler air or gases . . .



NIAGARA AERO AFTER COOLER cools a compressed gas, or air, below the temperature of the surrounding atmosphere, thus preventing the condensation of moisture in your lines. The gas will contain only half of the moisture left in it by conventional methods. Even drier gas can be produced if you require it.

In working with controlled atmospheres of inert gases to prevent undesired reactions, this dryness of the gas at low cost is a great advantage. The cost of the Niagara method is low because it uses evaporative cooling, saving 95% of the cost of cooling water (and its piping and pumping). This direct saving of cost pays for the Niagara cooler in less than two years.

If you use compressed air to operate tools or pneumatic equipment you save much in water and oil damage to tools and equipment, and in water damage to materials by using the Niagara Aero After Cooler.

Write for a bulletin, or ask nearest Niagara Field Engineer if you have a problem involving the industrial use of air.

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Experienced Field Engineers in Principal Cities of U. S. and Canada

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(Continued from page 96)

only a small deviation of the generator voltage.

Advantages of Amplidynes

Chief features of the amplidyne regulator are that it

1. Provides accurate, continuously acting no "dead band" voltage regulation and rapid smooth operation.
2. Permits close division of reactive current between machines and good system reactive control.
3. Extends the machine steady-state stability limit, permitting the use of lower short-circuit ratio generators, or higher external system reactances, or permitting larger underexcited reactive loading.
4. Permits safe underexcited operation with the reactive ampere lower limit.
5. Offers excellent reliability with little maintenance.
6. Increases reliability by eliminating the pilot exciter from the main generator shaft.
7. Is flexible enough to permit the use of a standardized design with almost any type of rotating exciter.

Tests and analytical studies have shown the amplidyne regulator to be suitable for all applications with the possible exception of those involving very special requirements. (The regulator may be used with any of the usual types of rotating exciter excitation systems; no special exciter design requirements exist.) Its general suitability has been shown by its wide application on small power systems, as well as by its use on the great majority of the largest power systems in the United States. These applications already have produced approximately 300 machine-years of amplidyne regulator service.

Microfilm Edition

The microfilm edition of POWER ENGINEERING, Volume 56, 1953, January to December issues inclusive is now ready. It costs $4.75 and should be ordered direct from University Microfilms, Inc., 313 North First Street, Ann Arbor, Michigan. DO NOT order it from us.

Please note that these microfilm volumes can be obtained only by firms, libraries, and individuals on our controlled and subscription lists.

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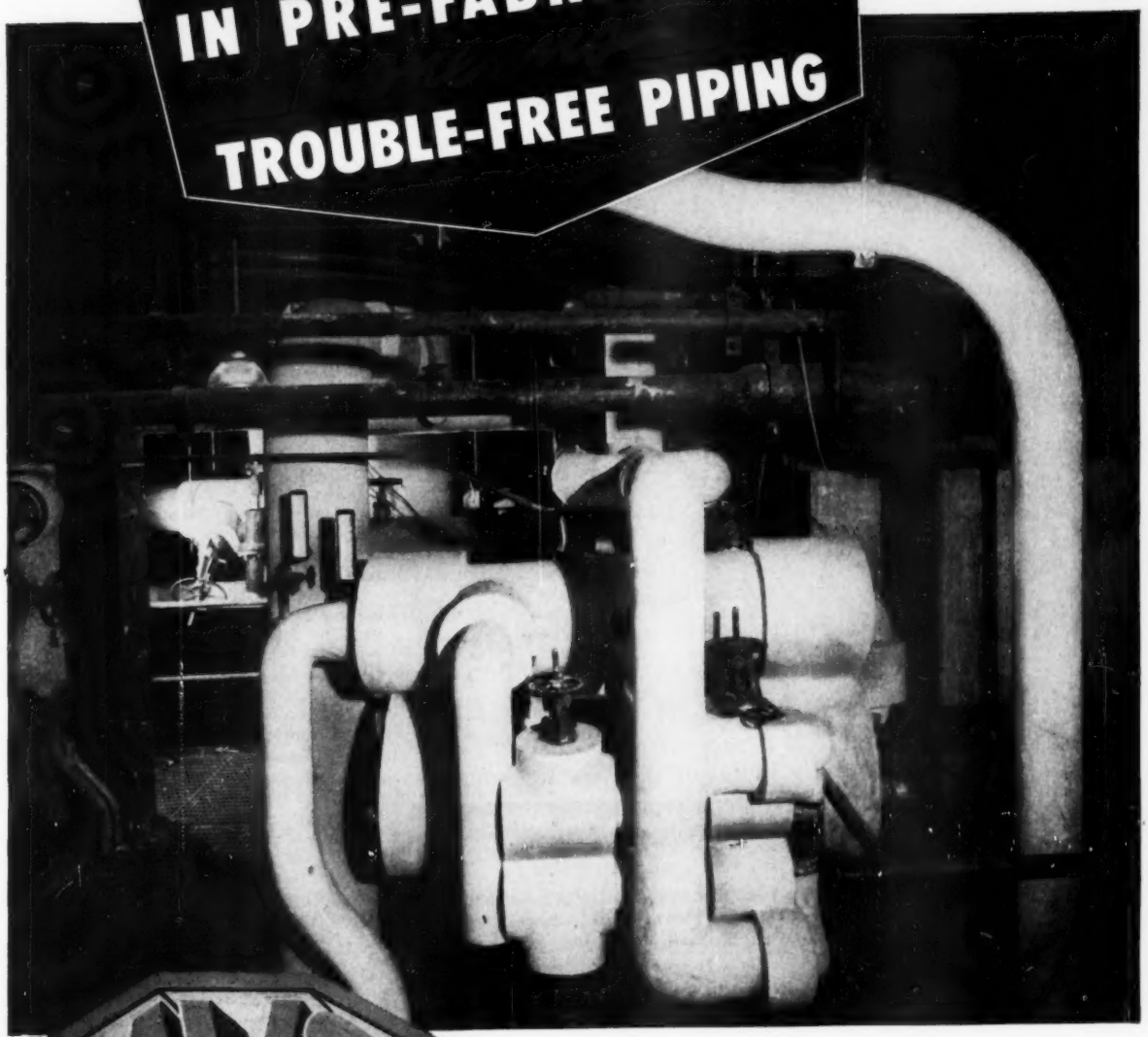

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Feedwater Heaters

(*Continued from page 65*)

(a) Heavy load where velocities are high, and tend to break the water stream as it is picked up by the first stage impeller.

(b) Very light load, particularly if the running fits in the boiler feed pump are not tight. This causes disproportionate heating within the pump.

2 — Move the boiler feed pump to a lower floor or into a pit.

3 — Install a separate booster pump of low specific speed design (substantially a condensate pump) ahead of the boiler feed pump.

4 — Install special boiler feed pumps with first stage of low specific speed design.

Transient Irregularities

Having tentatively settled on the equipment and established a satisfactory steady state net positive suction head and the best deaerating effect obtainable with the given heater, thought must be given to tendencies toward transient upsets.

When and if steam pressure is suddenly reduced in the heater say to 0.0 psig from a steady state operating pressure of 5 psig the corresponding temperature adjustment is roughly 15 deg, consequently the water not only in the heater but in the pump suctions will tend to flash.

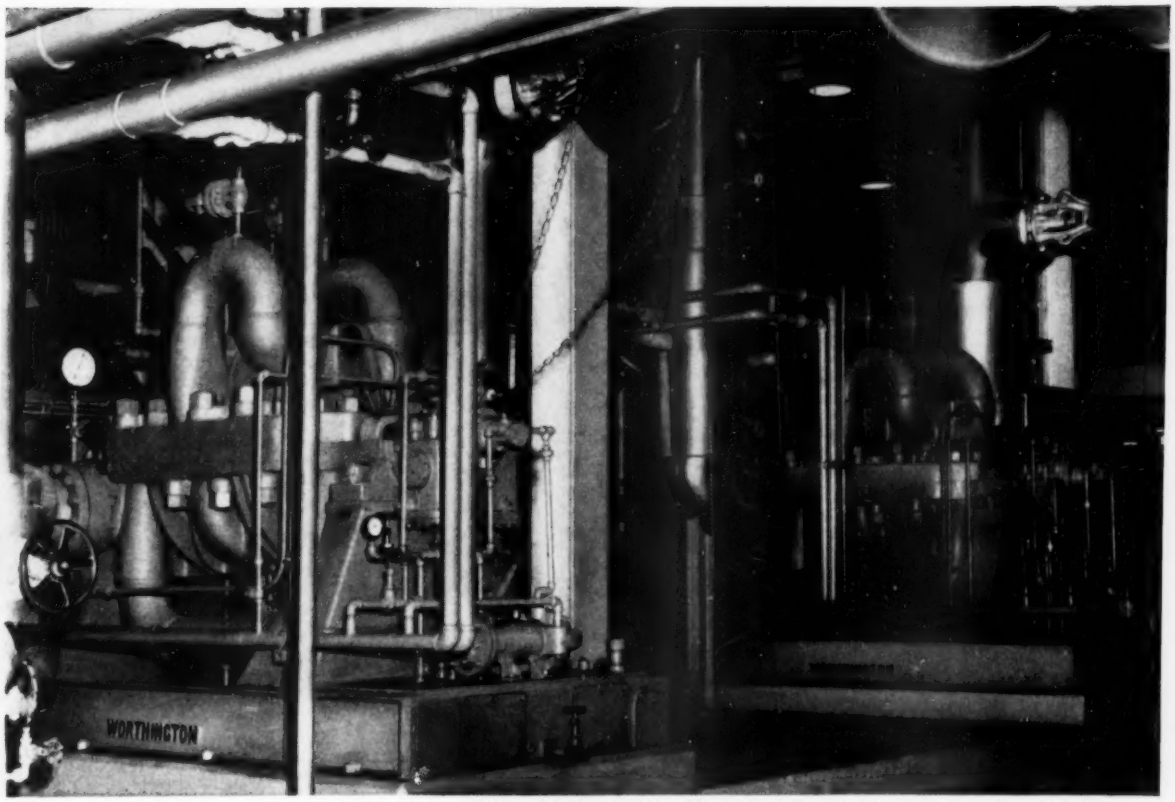
Quite often the drop in pressure in such a heater coincides with a drop in boiler load. This in turn causes the boiler water level to drop and more feedwater is needed, at once resulting in two unfavorable influences acting cumulatively to cause flashing at the suction eye of the 1st stage impeller — water too hot for the transient low pressure condition and a sudden increase in velocity within the pump.

Here then is the second major reason for a sensitive and reliable automatic steam feed to supplement the normal source. For a more detailed discussion of this subject refer to article — POWER ENGINEERING, June 1952 — "How Sudden Load Changes Affect Centrifugal BF Pumps" by Karassik, Bosworth and Schmid.

To avoid a severe pressure loss the suction piping from the deaerating heater or its hot water storage tank to the boiler feed pumps should be bigger than the pump suction connection, reducing smoothly at the fitting attached to the pump. We suggest not less than twice the area where the lines are simple — somewhat more if many fittings and changes in direction are involved. The main should be designed for similar low velocities. Smooth bends should be used where direction changes. Tees should be "double sweep" if cast, or wide base saddles or equivalent if welded.

Vent condensers are an integral part of all modern deaerating heaters.

(*Continued on page 102*)



THIRTY WORTHINGTON BOILER FEED PUMPS have been purchased by the Southwestern Public Service Company of Amarillo, Texas. The two boiler feed pumps above, installed at Southwestern's new Plant X, deliver 1165 gpm, at 1125 psi total head.

Worthington helps bring more power to the Southwest

30 Worthington boiler feed pumps installed by Southwestern Public Service since 1945

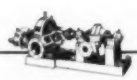
Plant X, ten miles north of Amherst, Texas, is the newest and largest of the Southwestern Public Service Company's eleven generating stations. Since September, 1945, Southwestern Public Service has been expanding, building new stations to meet the Southwest's increasing power needs.

Worthington has played an important part in this expansion. During the past eight years, thirty Worthington boiler feed pumps have gone into Southwestern Public Service power plants. In Plant X alone, Worthington has supplied, in addition to the boiler feed pumps, heater drain pumps, water softeners, sump pumps, air compressors, and the open feed-water heater.

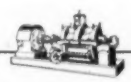
Power engineers everywhere have found that Worthington has kept pace with the increase in capacity and pressure of steam generating units and is prepared to furnish boiler feed pumps for any modern power plant requirements.

We'd like to hear about your own pumping problems. Get in touch with your nearest Worthington district office, or write directly to Worthington Corporation, Centrifugal Pump Division, Section C.3.5, Harrison, N. J.

C.3.5

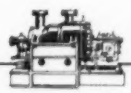


For Boiler Feed Service. Capacities to 1,500 GPM; Heads to 1,000 feet.



For Hotwell, Condensate, Chilled Water Service. Capacities to 1,400 GPM; Heads to 650 feet.

For Water Works, Circulation, Drainage, General Service. Capacities to 135,000 GPM; Heads to 400 feet.



For Boiler Feed Service. Capacities to 3,000 GPM; Heads to 7,000 feet.

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Centrifugal Pumps

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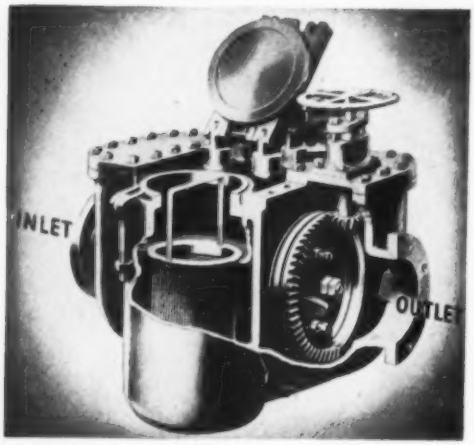
R-S Duplex Strainer



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- **ONLY ONE STUFFING BOX!**

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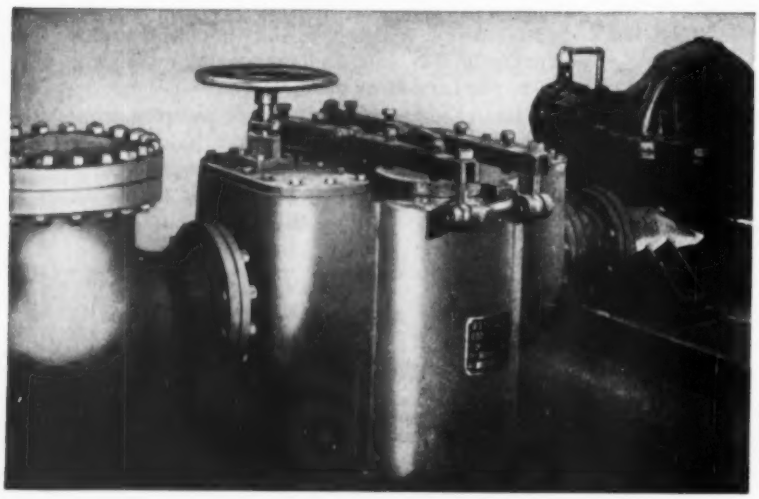


For more data circle 542 on Post Card

(Continued from page 100)

In any proposed rehabilitation of an older ordinary heater consideration should be given to adding a proportionately sized vent condenser. They have two major advantages:

(1) Heat otherwise thrown away as excess vented steam is saved.

(2) They usually increase the load capacity of the heaters.

A note of caution is called for here, since the incoming water temperature must not be raised enough for the vapor pressure to break the water stream before it arrives in the internal distributing devices. Where warm returns are accumulated in a large hot well and pumped to the heater the permissible temperature rise may be very limited. If hot returns are normally discharged direct to heater a greater rise will be possible.

Leakage in Vent Condensers

Tube leakage in a high level vent condenser may either interfere with heater water level control or break the water column or both depending on pressure relationships (which vary with valving arrangement and with load). This is often a "blind leakage" as in many cases it will overflow direct into the heater body. In some arrangements deaeration would practically cease.

Application

The above paragraphs point out some of the more common ailments in boiler feedwater heaters and a few irregularities in layouts. This is not a comprehensive listing.

A thorough study usually uncovers possible inexpensive modifications that will bring about major improvements in either everyday operating results or in ultimate life of parts (serviceability) or both.

Where deaeration is concerned, both the boiler feed pumps and the boilers are very sensitive and good deaeration is worth more than anything it is likely to cost.

The effect of poor deaeration and/or high acidity (low pH) goes beyond feed pumps and boilers. Even if severe cases are only spasmodic, enough effect will be carried over with the steam to cause accelerated corrosion-erosion in steam turbines.

While this has been written to call attention to the possibility of rehabilitating existing equipment for better serviceability and improved operation, the relative merits of completely replacing various units must always be given consideration.

Future Plans

All modifications to existing installations for lengthening the useful life of outdated equipment should be designed to fit into a satisfactory pattern when permanent replacements are made. Only too often expensive changes are made and then wasted when the equipment is replaced soon afterwards.

How to make packings last longer

Tips by Johns-Manville Engineers to help you keep production rolling

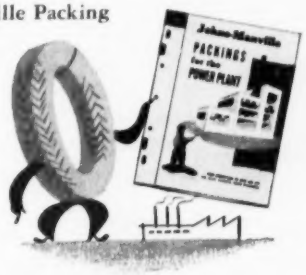
. . . and this new chart makes it easy to choose the right J-M Packings for your power plant equipment

A handy 6-page guide, "Johns-Manville Packings for the Power Plant" simplifies the selection and application of power plant packings. Covering 32 of our most popular styles, it tells at a glance what J-M packings to use . . . why they are recommended . . . and how to install them.

Its schematic diagram is spot-keyed to help you locate packing styles for various equipment units. Its brief group-headings help you select J-M packings for centrifugal and rotary services, reciprocating rods and plungers, valve stems, pipe flanges, manholes and handholes . . . to seal against steam, water, oil, brine, etc. . . . to withstand various temperatures and pressures. Its condensed packing descriptions give you essential buying information.

And a page is devoted to tips on proper installation to help you get maximum economy and efficiency from your Johns-Manville packings.

Your local Johns-Manville Packing Distributor will be glad to give you a copy of this handy packing selector, free of charge. Or write to Johns-Manville, Box 60, New York 16, N. Y., asking for Brochure PK-61A. In Canada, address 199 Bay Street, Toronto 1, Ontario.



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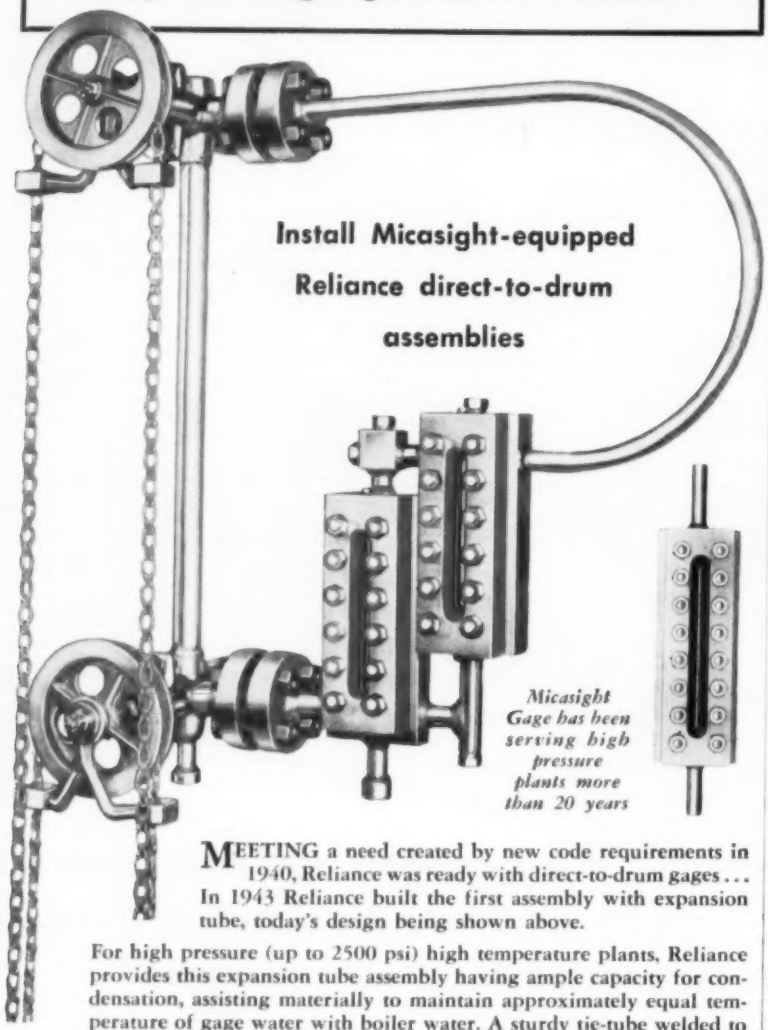
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Micasight Gage has been serving high pressure plants more than 20 years

MEETING a need created by new code requirements in 1940, Reliance was ready with direct-to-drum gages... In 1943 Reliance built the first assembly with expansion tube, today's design being shown above.

For high pressure (up to 2500 psi) high temperature plants, Reliance provides this expansion tube assembly having ample capacity for condensation, assisting materially to maintain approximately equal temperature of gage water with boiler water. A sturdy tie-tube welded to both Reliance Gage Valves gives necessary rigidity between boiler connections. Reliance all-welded gage assemblies have more than sufficient ruggedness to meet severest conditions.

Extra gage-reading safety and long window life is assured by the exclusive Micasight Gage which uses non-shattering mica windows securely clamped in short, wide-bar, non-breathing bodies. Reliance provides access to clean out all passages, with entrances guarded by non-freezing plugs. Gage is connected to valves by ring-joint flanges — no nipples or packing glands. The Micasight is the safest water gage known. *Write for full information, to the factory or your nearest Reliance representative.*

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BOILER SAFETY DEVICES

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Electromet's New Plant

(Continued from page 83)

Water for the power plant condensers and for industrial processes is drawn from the Ohio River through a screen house; and a large pump section in the basement, 18 ft below normal river level, contains horizontal motor-driven centrifugal pumps for each of the 30,000-sq ft turbine surface condensers, as well as a large number of service pumps that supply about 110,000 gpm of process water to the factory. Entire power plant and factory have been built on ground well above the maximum recorded flood levels of the Ohio River at this point.

The main turbines, of course, supply extraction steam for closed and open feedwater heaters in the regenerative cycle, in addition to the steam extracted for process. Make-up water is provided by a battery of six 60,000-lb per hr evaporators. Condensate from the plant process equipment flows back to the boiler house, so that the normal amount of boiler make-up is about 8 per cent.

Feedwater systems of boilers No. 1 and No. 2 are interconnected, also their steam headers; boilers No. 3 and 4 are connected in like manner. But there are no other interconnections between the units except at the bus bars and they are designed for normal operation on the one-boiler-per-turbine principle.

An interesting feature of the plant is the exterior wall construction, which is also used on the factory buildings. This wall consists of panels 8 ft square, made up of insulated precast concrete panels secured to the building steel work. Each panel consists of a 5-in. thick "sandwich" of two layers of concrete, each about 1-$\frac{3}{4}$ in. thick, with a core of 1$\frac{1}{2}$ in. of insulating material between them. Further details will be given later.

Full automatic combustion control for the boilers and complete remote automatic and manual control for turbine generators and all auxiliaries are provided in this power plant. Each generating unit has its individual control panel convenient to the unit, Fig. 2, while the controls for each pair of boilers are on panels located between the pair on the main operating floor. However, there is a centralized control room for the entire plant, Fig. 3. This includes a load frequency control system and all electrical controls for co-ordinating electrical operations within the processes and also with the utility interconnection when necessary.

The plant was designed jointly by the engineering department of the Electro Metallurgical Co. and Ford, Bacon & Davis. Operation of the plant is under the supervision of John C. Curry, superintendent of power, and Harry T. Smith, assistant superintendent of power, for Electro Metallurgical Co.

Atomic Data

(*Continued from page 86*)

tional Laboratory. Yet much more detailed information on the electromagnetic pumps was available in the Liquid-Metals Handbook, referred to previously, as early as June 1950.

As for basic data, the three lecture series in nuclear physics, MDDC-1104, MDDC-1175 and AECD-2664, listed in the adjoining columns, contain far more fundamental data on the subject than the average engineer can assimilate in a year. Much of the material in these lecture courses is, of course, of interest only to nuclear physicists, but if engineers are ever going to design and operate nuclear power reactors it will be necessary to have a thorough understanding of these basic principles.

It is true that, insofar as the power engineer is concerned, he is largely concerned not so much with what goes on inside nuclear reactors but in the way to get the heat out of them. Yet this whole problem of heat transfer is vitally tied up with reactor design and so the more the power engineer knows about reactor details, the better he will be able to solve the difficult heat transfer problems which constitute perhaps 80 per cent of the problem as a whole.

Overall Picture

For an overall picture of the thinking on the subject of atomic power, the book for the Joint Committee on Atomic Energy, "Atomic Power and Private Enterprise" listed in the adjoining columns deserves special mention. This book discusses all aspects of the problem, scientific, political, industrial, and legal, and for one starting out new in this field, it is a most valuable volume.

In addition to the books and reports listed in the adjoining columns, attention is directed to the Semi-annual Reports of the U. S. Atomic Energy Commission. Thirteen of these reports have been published to January of this year. All contain data and information of general interest, and they are available to the general public at the Superintendent of Documents Office, Government Printing Office at Washington at prices which range from 35 to 50 cents each.

Last but not least is the magazine *Nucleonics*. This is a technical magazine for nuclear physicists and engineers and is a most excellent source of information on all phases of nuclear energy development.

The books and reports listed on these pages, of course, constitute only a very small part of the literature available. The proceedings of the technical societies — the AIEE, ASME and the American Physical Society — contain innumerable papers on general and specialized topics in this field and most of these are easily available at various technical libraries throughout the country.

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To both industrial and utility power generating stations, specifying Richardson means—

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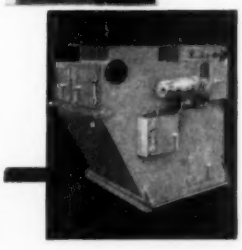

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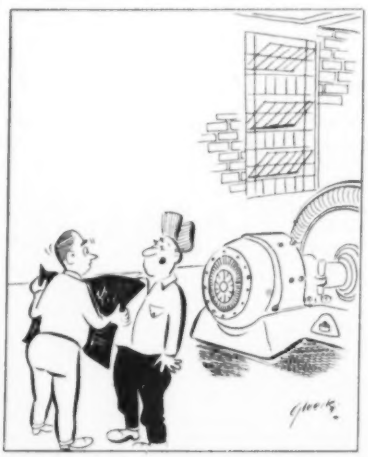
WATER CAN CARRY YOUR COAL AND ASH

(Continued from page 93)

292 tph pipeline (Table III) is $11,955,000. Investment for the belt system would be much higher. The belt alone represents an investment of $15,000,000. However, operating costs for the belt will be lower than for the pipeline. Total power required for the belts is 12,000 hp compared with 20,309 hp (Table II) for the pipeline. Power costs at 0.012 dollars per kw hour is $2,600 per day for the conveyors compared with $4,365 for the pipeline, a saving of 25¢ per ton. Coal size may range from fines to 12 in lumps on a 30 in belt, and the coal is handled gently with minimum degradation, whereas for the pipeline it has to be crushed. Finally, in any project such as this, there may be the additional problem of 2-way transportation — as in the 30-mile belt system that has been suggested between the Ohio River and Lake Erie to carry coal to, and iron ore from, the lake — not difficult with reversible belts but impossible, without radical design changes, for a pipeline system. Large quantities must be moved continuously for pipeline transportation to be economical, because high fixed charges make intermittent operation costly.

Wood Stave Line

The International Nickel Co. of Canada, Ltd., has completed a 7½ mile wood stave pipeline through which bulk concentrates from 3,000,000 tons of nickel-copper are pumped annually. The system has 12 miles of trestle to assure a slope to and from each of five relay pumping stations so that the concentrates will be self-draining in case of power failure. Water is added to the concentrate to make a pulp which flows through the pipes at 800 tpm. The operating data should be very interesting when the engineers disclose the figures.



"Sure I can read blueprints but there ain't much writin' on 'em ever."

New ENGINEERING BOOKS

Fractional Horsepower Electric Motors. By F. G. Spreadbury. First Edition, 342 pages, 6 by 9 in.; cloth. Published by Pitt-man Publishing Corporation, 2 W. 45th St., N. Y. 1951. Price: $7.50

The increasing use of small motors, both within and outside the industrial sphere, makes this book of considerable value to electrical engineers and designers of equipment. The principles of most fractional hp motors are treated and a basis for design is given. Other important matters dealt with includes speed control and determination of performance characteristics.

A good idea of the contents of this book may be had from the title chapters which are as follows: 1. The Direct Current Motor, 2. Direct Current Motor Construction and Design, 3. Polyphase Induction Motors, 4. Single Phase Induction Motors, 5. The Universal Motor, 6. The Repulsion Motor, 7. Synchronous Motors, 8. Miscellaneous Motors, 9. Performance Characteristics of Fractional HP Motors, 10. Motor Control.

* * *

Fundamentals of Automatic Control. By G. H. Farrington. First Edition, 285 pages, 5½ by 6¾ inches, cloth. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York. 1951. Price $5.00

This book is primarily intended for those who are interested in any of the applications of automatic control. It presents a general survey of the wide field which such applications may involve and undertakes an investigation of the basic nature of the problems which may be encountered. It deals with the underlying principles which effect automatic control performance rather than with the specific details of plant or apparatus.

As the author points out, the analysis by which the fundamentals of this subject can be reached is greatly facilitated by the use of mathematical methods. Accordingly, the author has used such methods, where necessary, but has introduced them in a manner which makes them understandable even by readers not accustomed to their use.

* * *

Direct Current Machinery. By Charles S. Siskind. First Edition, 320 pages, 6¼ by 9¼ inches, cloth. McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. 1952. Price: $6.00

This book is an excellent up to date treatise on present day principles and practices of direct current generators, motors, and auxiliary machinery. The author is

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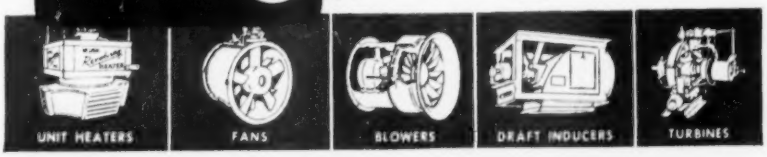

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Assistant Professor of Electrical Engineering at Purdue University and this volume represents his experience with direct current machines, extending over a period of many years in both industry and teaching. It is clearly written and every topic is carefully discussed in terms of fundamental principles and its application to present day practice. A real attempt has been made to avoid confusion by simplifying complicated wiring diagrams and neglecting obsolete arrangements at the same time giving attention to refinements and details of design. The topics follow one another in logical sequence and without gaps, while especially important subjects receive the emphasis of reworded repetition supplemented by the solution of appropriate problems. Simplified graphical constructions are employed not only to generalize the operating characteristics of the many types of dynamos but to show that they yield reasonably good quantitative results.

There is an excellent chapter dealing with the control of motors and also a chapter on special machines, circuits, and applications. This considers third brush generators, regulator control generators, the Rosenberg Generator, and the Amplidyne. A final chapter deals with the subject of commutation.

★ ★ ★

Linear Scale Non-Logarithmic Slide Rules. By Morris Lewis Groder. 64 pages, 5½ by 8¼ pages, paper covered. Published by G & G Corporation, 2003 East 12th St., Brooklyn 29, New York. 1953. Price $2.98

The principles described in this interesting little book are presented as tools for constructing general, special, and emergency slide rules. The illustrations reveal that the shape and size of these computers do not conform with the commonly accepted versions of the slide rules though the author has constructed Linear scale slide rules on logarithmic slide rules. The computers described in this book, however, were expressly designed from the viewpoint of convenience in construction and application. The linear scale slide rule is not based upon the logarithmic principle. All scale divisions are equally spaced; there is no gradual squeezing together of the scales as is found on the logarithmic slide rule.

The principle of this linear slide rule is easy to grasp; one which we learned in high-school, and one you will all recall as soon as you see it described. As the author points out, the linear scale slide rule has many advantages, some of which are increased scale accuracy, construction with simple drawing instruments, low manufacturing costs, scale reading facility, and simple construction of scales involving combinations of addition, subtraction, multiplication and division. Scales for polar rectangular co-ordinate conversion for obtaining roots, powers, logarithms and trigonometric func-

tions may be included without recourse to mathematic tables, computation, or special construction tools.

★ ★ ★

Power Plants for Aircraft. By Joseph Liston; 577 pages; 6½ by 9¼ in., cloth. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York. 1953. Price $8.50.

Although this book may be of little direct assistance to industrial power engineers, it is nevertheless a book that many engineers outside the aircraft industry would find of considerable interest, since it shows what the aircraft power plant designer has been able to accomplish by force of necessity. It is quite possible that some of the practices of the aircraft engine designer might be used to advantage in the design of other types of power plants. This is particularly true with respect to the turbo-prop type of power plant. The gas turbine is just coming to be used in industry and the things which the aircraft engine designer has learned in the application of turbo-jets and turbo-props may be of considerable value to the designer and user of industrial gas turbines.

One of the fascinating things about the aircraft power plant is its low specific weight per rated brake hp. Where industrial and automotive diesel plants will run anywhere from 15 to 60 lb per hp, aircraft engines nearly all fall below 3 lb per hp and in the larger sizes above 1000 hp, the specific weights run between 1.2 and 1.5 lb per hp. Though the operating principles of industrial, automotive, and reciprocating types of aircraft engines are generally similar, the different specific weight requirements introduce a host of variations and detail and, of course, the use of different materials.

The author of this book is a professor of aeronautical engineering at Purdue University. His primary object in writing this book was to provide a text and reference book for seniors and beginning graduate students in aeronautical and mechanical engineering. The emphasis is on fundamental principles and a broad approach involving the consideration of all types of aircraft power plants. Included in the presentation are accurate and comprehensive comparisons of the many types of jet and reciprocating power plants, a fundamental analysis of the theoretical power plant cycles, a comparison of actual engine performance, with the theoretical cycles, and a discussion of some of the practical problems encountered in operation and testing. Nearly all advances in the fields that have been declassified are discussed fully within the limits of government restrictions. The book considers the basic principles of reciprocating engines, turbo-jets, turbo-props, ram jets, rockets, and potential nuclear power plants.

★ ★ ★

Control of Electric Motors. By Paisley B. Harwood; Third Edition; 538 pages; 6¼ by 9¼ in.; cloth. Published by John Wiley &

ENCO BURNERS

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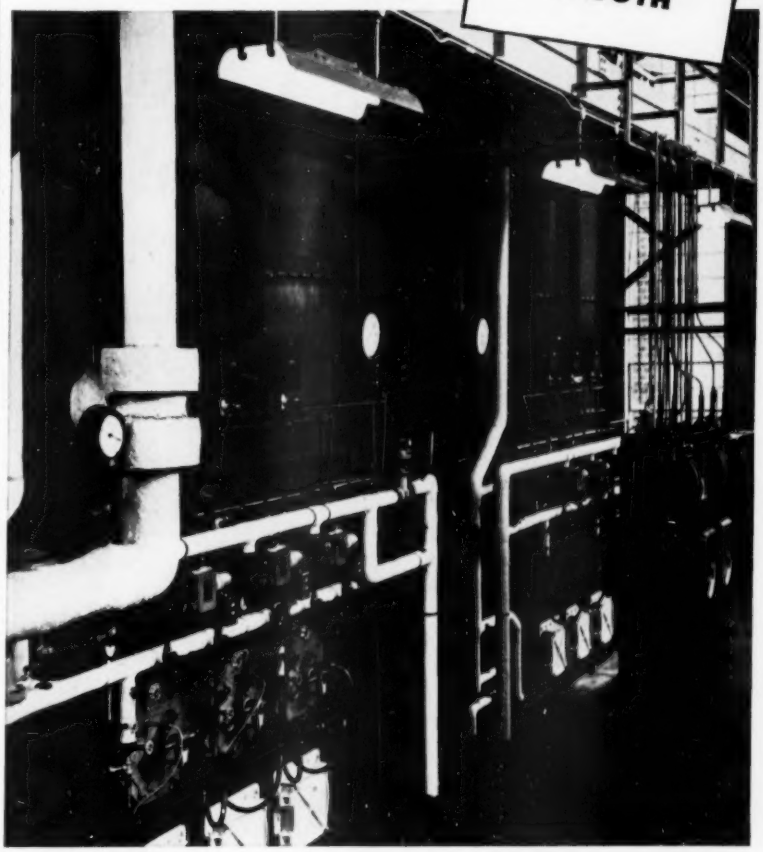

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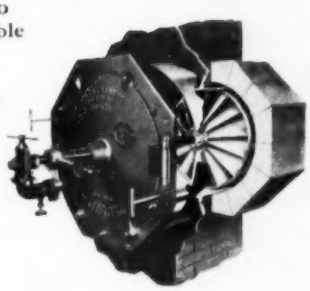

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Photo above shows the Green ID Fans being installed in the Chesterfield Power Station Extension of the Virginia Electric and Power Co., at Drewrys Bluff, Virginia.

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Sons, Inc., 440 Fourth Ave., New York. 1952. Price $7.50

The success or failure of any electric motor installation often depends upon the selection and installation of the proper type of controlled equipment. At one time, the selection of a motor controller was a relatively simple matter but, as the number of types of motors and applications has expanded and as motors have been designed to closer tolerances, the selection of controller equipment has become much more important and complex. In order to make a successful installation it is necessary to understand the factors which enter into the selection of the machine, the motor, and the controller, and therefore, to have a good working knowledge of the characteristics of all three devices.

This is the third edition of Mr. Harwood's book. When the first edition was published, in 1936, very little had been written on the subject and it had received almost no recognition in college engineering courses. The picture is quite different today. In addition to the great increase in the electrification of industry, a number of books and hundreds of papers have been written and now almost every college electrical engineering course includes some work on controls. When the first edition was published, electronic motor control was in its infancy. Today electronic motor control is almost an industry in itself and there are many excellent textbooks available on this branch of the control field. Hence, the author has deemed it best to omit the material on electronics. In its place a chapter on regulating devices and circuits has been added. This third edition includes a great deal of new information on circuits and devices and calculations used for the regulation of voltage, speed, tension, etc., numerous industrial applications, descriptions of electronic amplifiers, rotating regulators and positioning servomechanisms and basic principles of regulating devices. New photographs are included, replacing the outdated ones. New wiring diagrams have been specially drawn for this edition and all the references have been considerably revised and expanded. Included are 350 problems plus factual data, upon which hundreds of additional problems can be based. The whole book, in fact, has been revamped to meet the needs arising from this rapidly expanding phase of industry.

* * *

Harwell, The British Atomic Energy Research Establishment. 128 pages, 6 by 9½ in., cloth. Published in this country by the Philosophical Library, 15 E. 40th St., New York. 1952. Price $3.75

Most of the material on the development of atomic energy available to the general reader in this country has had its origin in American sources; in the work done at Oak Ridge, Argonne, Brookhaven, Hanford, Los Alamos, and Berkerly. The great im-

petus given American research and development by the war-time Manhattan project and the subsequent continuation of this work by the US Atomic Energy Commission, has made the work of other nations appear of secondary importance.

This, however, is not necessarily true. If work in other countries was somewhat slower in starting, the character of the work done has been quite on a par with that done on this side of the Atlantic and often with considerably more slender resources. In England, for example, the work done at Harwell since 1946 deserves a high order of recognition. Harwell was the first establishment in the world where the heat from atomic energy was first used to heat buildings.

Harwell is the research branch of the British Atomic Energy program. The production branch is at Risley in Lancashire. Located not too far from London and only 12 miles from Oxford permitting close University contact, Harwell's tasks are to do fundamental research and development in all aspects of atomic energy and to give assistance to the production branch. Both Harwell and Risley are operated under the jurisdiction of the Ministry of Supply.

This book describes the institution and its work. It covers all details of the laboratory's operation, is well illustrated with excellent photographs, and gives American readers an excellent picture of Britain's counterpart to our own Atomic Energy Program. In England, this book is published by the British Ministry of Supply.

* * *

Heat Transfer Phenomena. By R. C. L. Bosworth. 210 pages, 5¾ by 8¾ in., cloth. Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York. 1952. Price $6.00

The subject of heat transfer is one of the oldest branches of science and one which is perhaps most universal in its manifestations. In almost everything we do, throughout the whole of our lives, in our dealings with animate and inanimate objects alike, heat transfer plays an important role. Yet, it is among the most controversial of all subjects and in many ways, one of the most complex. It is slow moving. Never, throughout its long history, has it shown any period of phenomenal growth comparable with say the recent expansion of nuclear physics. As compared with, for example, the flow of electricity, the flow of heat is slow and cumbersome and there are no simple experimental means for restraining the flow along well defined channels. As a consequence, experimentalists, in search of an easy path to academic distinction, have tended to avoid this subject as unwieldy and unprofitable. Nevertheless, because of its complexity and its universal importance, the subject of heat transfer is of perennial interest and through the years it has been the subject of innumerable papers, treatises, books and symposia.

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Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Valve and Angle Valve.

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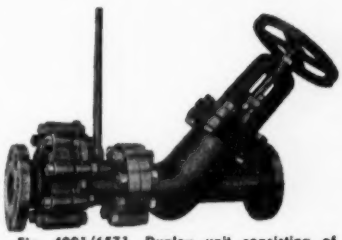

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Valve and Y Valve.

Fig. 6571/6561. Duplex unit consisting of Y Valve and Angle Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Valve and Y Valve.

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This new book, by Dr. Bosworth, differs from others in the same field in that it treats heat transfer as a particular example of the class of transport phenomena. In other words the transfer of heat involves actual movement of certain mobile parts of the assembly in which the transport process occurs. The author deals first with the properties of this class of transport phenomena and shows how these properties can be modified by the nature of the various features of the transport process, such as the number of individual units responsible for transport and the speed and geometry of the paths traced by these units.

The classical subdivisions of heat transfer — conduction, radiation, and various forms of convection are then explained as particular types of transport processes. More complicated phenomena are treated as processes involving the simultaneous transport of heat in one or more other properties.

Apart from the unified presentation of all the different aspects of heat transfer phenomena, which is of particular interest to those concerned with teaching, and those concerned with research in allied subjects, the volume gives a concise account of all the more important recent advances in our knowledge of heat flow and, as such, should be of particular interest to the technologist, the mechanical or chemical engineer, the industrial chemist and the applied physicist.

Dr. Bosworth, who is an Australian, is a world authority on the subject he discusses and his book is unique in that it is probably the first Australian work to have been published in this country for simultaneous distribution in America and the United Kingdom.

* * *

Weldability of Metals; size 5¾ by 8¾ in.; 141 pp; illustrated; paper binding; published by The Lincoln Electric Co., Cleveland 17, Ohio; price 50 cents in United States, 75 cents elsewhere, postage paid.

This booklet gives answers on how to weld ferrous and non-ferrous metals. Frequent requests for information on how to weld various types of metals led Lincoln to publish this information in a special book so that it could be made widely available at low cost. For this reason, this section on Weldability of Metals has been reprinted from the 9th edition of their standard welding reference Procedure Handbook of Arc Welding Design and Practice.

* * *

Water, A Study of Its Properties, Its Constitution, Its Circulation on the Earth, and Its Utilization By Man. By Sir Cyril S. Fox. First Edition, 148 pages, 6¼ by 10 in., cloth. Published by the Philosophical Library, Inc., 15 E. 40th St. New York 16, New York. 1952. Price: $8.75

According to the chronology of the English Bible, as calculated by Archbishop Ussher in 1650, Noah's flood occurred about 2400 B. C., in the drainage area of the Euphrates. It seems, however, that there is some error in the translation covering the word or name Ararat, which in Hebrew can mean "sacred land", as distinct from the mountain nearly 17,000 ft above sea level on the borders of Iran (Persia).

A moment's consideration will show that the distribution of land and sea today is 57 million square miles of continental areas, with an average height above sealevel of 2500 ft, and 140 million square miles of oceanic areas with a mean depth of 12,500 ft. If, therefore, Noah's flood raised the level of the sea 17,000 ft to cover Ararat, the amount of water added to the oceans would need to be 1.33 times the volume already in the oceans. The problem on the basis of evaporation of sea water for rainfall on the land would thus not only concern the source of the rainfall supply, but the disposal of the run off flow after the rainfall. Incidentally, it also means a rainfall of 16,250 ft in 960 hours or roughly more than 200 ins. an hour. These calculations support the opinion of many devout people that some elevated land in the Euphrates alluvial plain was meant as the "sacred land" when the word Ararat was used in Genesis.

This reference to Biblical history is only one of the countless other fascinating facts concerning water in this book by Sir Cyril Fox, Doctor of Science, lately Director of the Geological Survey of India. It deals with water in its widest manner, without, however, entering into exhaustive detail. It was written to meet the needs not only of civil engineers but of all others who have need for a modern book dealing with the scientific and practical aspects of the study and utilization of water. Written in as non-technical manner as possible, but technically correct and up to date, it presents innumerable facts concerning water of interest to all of us since, without water, there would be no life on earth. Besides dealing with the physical and chemical properties of water, as it usually occurs as rain and snow or obtained from lakes and rivers, it also covers the emergence of water from deep within the earth as hot springs and volcanic eruptions.

Few people, perhaps, know that an immense quantity of water is held in the sub-crust of the earth, 10 miles below the minus 12,500 ft of the ocean floor. This water is held in the pore space in the rocks. If this water, 19,700,000 cu miles, were released to the surface of the earth, it would cover it to a depth of 528 ft. There is thus a difference between the formation of a cumulus cloud on a sunny day and the cloud that mantles an active volcano — the water vapor in the cumulus cloud perhaps arose from the sea a few hours previously while the volcanic vapor returned to the atmosphere after millions of years travel through the earth's crust.

It is fitting that this book should appear at a time when water is of overwhelming importance in nearly all countries of the world. Water is the most vital thing we have; without it, all life would perish from the earth. It is nothing short of marvelous that a substance of such abundance and so simple in constitution should possess the many characteristics which guide the processes governing the changes on the face of the earth. By its presence in the atmosphere, it tempers the sun's heat. The rain that falls scours the hills and carries the sediment into the rivers and deltas. The streams remove almost unbelievable amounts of solid matter from the rocks in solution and carry these dissolved materials into the sea to concentrate them there. The water that percolates into the rock crust of the earth may penetrate to great depths and take part in the formation of mineral deposits and emerge as thermal springs. In its deeper reactions it may lower the melting points of highly heated rocks and be discharged as steam during volcanic eruptions.

The book is illustrated with some excellent photographs and one of the more interesting features to us in this country is the section which deals with the great land reclamation schemes of the United States.

* * *

Metadyne Statistics. By Joseph Maximus Pestarini. First Edition, 416 pages, 6¼ by 9¼ in., cloth. Published, jointly, by the Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., New York. 1952. Price: $9.00

This book brings to readers of American electric literature a new term, a term, however, which has been in general use in Europe for a number of years. Though the term "Metadyne" may be new here, American engineers have been using Metadyne machines in the form of Amplidynes and Rototrols for a number of years.

Through the pages of scientific history behind this book, run the names of men of Italy, France, Belgium, England and the United States. Its cosmopolitan background began in the 1920's when Dr. Pestarini, in studying commutation, recognized and defined the new group of machines to which he gave the name "Metadynes". The manuscript recording this investigation and the author's theoretical predictions concerning Metadynes won the Montefiore prize at the International Contest in Belgium in 1928.

Since then, Metadynes have been constructed in many countries. Although the field of direct current machines was well established at the turn of the century Dr. Pestarini brought into it invigorating new scholarliness generality and invention, which led, in time, to the testing of such machines in new and powerful roles. Certain of these generalized direct current machines, or Metadynes, may, without too great liberty, be called electromechanical vacuum tubes. Metadyne machines are usually used in systems of machines rather than individually as is conventional machinery. These systems of machines can be designed to absorb power under prescribed relationship between torque end speed as well as response time.

HELPFUL BULLETINS

(*Continued from page 36*)

guides are quickly attached to torches and provide a means for fast, accurate cutting of circles, straight lines, angles, bevels. Shows small and large circle guides, and a straight-line guide. New Era Engineering Co.

130 Hints on Welding — What you need to know to apply any of 11 alloys, including silver solder and their companion fluxes, etc. is told in this folder, Form 3453. Condenses technical instruction into lay language — it's easy to read, easy to follow. All-State Welding Alloys Co., Inc.

131 Stainless Steel Electrodes — Twenty-pp Bulletin AR53-16 covers company's Arcaloy stainless steel electrodes. Explains two basic types — lime coating for all-position welding with d-c reverse polarity, and a-c d-c for welding of chrome nickel steels with all types of a-c or d-c welding equipment. Provides individual descriptions of the 23 regular and special analyses of electrodes, weld metal properties, welding procedures, current ranges and AISI type numbers. Alloy Rods Co.

OTHER EQUIPMENT

132 Engine Maintenance Manual — Form 30562, 24 pp, latest of this company's cartoon-type instruction booklets, shows proper operation and care required for four large V-type diesel engines. Provides a detailed discussion of the maintenance of these engines in conversation style, along with easily-understood diagrams. Caterpillar Tractor Co.

133 Conveyor and Elevator Belting Tips — This 32-pp manual on installation, maintenance and care of conveyor and elevator belting shows ways to improve belt service and lengthen belt life. Includes a discussion of belt design, covers, reinforcements and grades, and a review of engineering information needed to specify a conveyor belt. Repair methods, splicing and fastening are also covered, and there's a table listing common conveyor belt maintenance problems with their causes and remedies. A new conveyor belt system for handling wet, corrosive, sticky or freezing material is also described. The B. F. Goodrich Co.

134 Where Vibration Figures — This bulletin describes Vibra-Sorbers, designed to isolate vibration from connecting suction and discharge lines to refrigerations and air conditioning machinery, pumps and turbines. Illustrated; gives specifications, installation tips. Flexonics Corp.

135 To Clean Softeners — Zeotone, a preparation for cleaning and toning up salt-regenerated water softeners, is described in this folder. Stresses advantages of the preparation; tells when and how to use it, giving step-by-step directions for cleaning both heavily-fouled units and those not badly fouled. Calgon, Inc.

136 Power Plant Growing? — Engineers of industrial plants which require expansion of power plant facilities will be interested in this technical article on deaerating feedwater heaters. Tells how they serve to protect plant equipment and pipe lines from corrosion while absorbing and utilizing various available sources of heat to preheat the feedwater. Design characteristics of several types of these heaters are tabulated and selection factors outlined. Graver Water Conditioning Co.

137 What Fuel Researchers Are Doing — This interesting 28-pp brochure tells of the research into energy and fuels being done at Battelle Memorial Institute. Subjects discussed include solutions to boiler problems, flame oscillation studies, coal gassification appraisals, spark ignition reaction studies, internal combustion phenomena research, high-performance fuel investigations. Tells how institute serves industry. Battelle Memorial Institute.

140 Corrosion-Resistant Equipment — A 64-pp booklet on selection and use of manufacturer's corrosion resistant equipment, Bulletin F-6, is made available to qualified power engineers. Gives general information on the various grades of Haveg, properties, design principles, and surface finishes. Describes and pictures standard pipe, fittings, valves, pumps, fume systems, tanks, towers, pressure and vacuum equipment, and other equipment. Also describes cements. Haveg Corp.

. . . Outstanding Among This Month's Catalogs . . .

138 Protective Relaying — Booklet GET-1768A, 72 pp, is a new and expanded edition of "The Art of Protective Relaying," explaining the broad principles of modern practice in the protective relaying of power apparatus. Contains information on types of relays for protecting generators, transformers, transmission lines. Outlines procedures used in evaluating power apparatus and system characteristics to determine proper application and settings of relays. Also gives list of available relays with references to detailed literature. General Electric Co.

139 Zeolite Water Softeners — Twelve-pp Bulletin WC-108, on zeolite water softening, is of particular interest to power engineers. Explains distinction between sodium cycle and hydrogen cycle of zeolite softening and shows differences in results obtained by the two processes. Describes design and operation of equipment used in zeolite water softening, and methods for controlling various operations in softening and regenerating processes. Discusses modern ion exchange materials, and provides a table of characteristics of cation exchangers commonly used in company's softeners. Includes table of flow rates. Graver Water Conditioning Co.

141 Condenser, Heat Exchanger Tube Handbook — This 156-manual presents properties of copper-base condenser tube alloys and their applications. Types of corrosion affecting tubes from the water side are discussed and illustrated with micrographs and charts. Subjects covered include effect of water composition, pH values, dissolved gases, temperature variations, steam erosion-corrosion. Comparative properties of standard condenser tube alloys are listed. Book also deals with various duplex tube combinations of ferrous and nonferrous alloys designed to offset effects of two different corrosive media on outside and inside of tubes. Available to qualified power engineers; state job title when requesting this book. Bridgeport Brass Co.

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THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the catalogs and bulletins. Use the postage-free card below for your request

VALVES, TRAPS, PIPING AND ACCESSORIES

201 Safety Valve Engineering Data — How company's safety valve works and its operating advantages are explained in Bulletin 707. Includes dimensions on valve types, and also tables on superheat correction factor. Manning, Maxwell & Moore, Inc.

202 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

203 Valve Specialties — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

204 For Quick Valve Selection — Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and thumb indexed, includes pressure-temperature chart. The Ohio Injector Co.

205 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

206 Cast Steel Valves — This 56-pp catalog on cast steel valves includes information on globe, angle and check valves in 300, 600, 900 and 1500 lb pressure classes. Parabolic disc valves for hand or motor control of volume are also described. In addition to standard information on construction features, dimensions and weights, the booklet contains complete data on material specifications, preparation of welding ends, flange facings, and ratings. Edward Valves, Inc.

207 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

208 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

209 Regulating Valves — Bulletin 313 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured body engineered for high capacity at low pressure drop. Leslie Co.

210 Solving Steam Trap Problems — This 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co.

211 Steam Trap Book — Catalog J, 44 pp, serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

212 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

213 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline, also piston-operated traps. W. H. Nicholson & Co.

214 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how to-do-it features. Includes 8-pp valve selection guide. Crane Co.

215 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

216 Handbook on Fittings, Flanges — Catalog wf-1950, 68 pp, offers working

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POWER ENGINEERING

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information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

ELECTRICAL

218 Electrical Maintenance Tips — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is provided. Westinghouse Electric Corp.

220 Wire, Cable Ordering Guide — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A technical engineering data section is included. United States Rubber Co.

221 Power Distribution Practices The 28-pp "Industrial Power Distribution Idea Book" (Bulletin GEA 5900) is a guide on electric power distribution practices in large and small plants. Covers utility distribution practi es; methods of buying electric power; what to do when a choice of primary voltages is available; application of primary switches and circuit breakers; types and arrangements of primary cables; and types of load-center distribution systems. General Electric Co.

222 Motor-Generator Reference Book — Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control, general characteristics and representative dimensions. Allis-Chalmers Mfg. Co.

223 Meet Microwave — "An Introduction to Microwave," 20 pp, provides a semi-technical description of RCA microwave equipment and is illustrated with photos, charts, diagrams, etc. Describes microwave radio, tells how it works, gives propagation characteristics, operational advantages, economic factors influencing choice of frequencies, and desirable design characteristics. Also deals with multiplexing, telemetering and remote control features. Microwave Communications Section, Radio Corp. of America.

PUMPS, PUMPING

224 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

225 Condensed Pump Data — Form 4383-J covers more than 20 types

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C434 ROTOJET Junior Air-driven Motor, flexible coupling, expanding brush.

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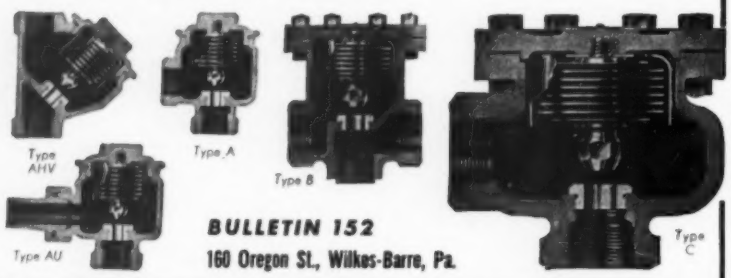

BULLETIN 152

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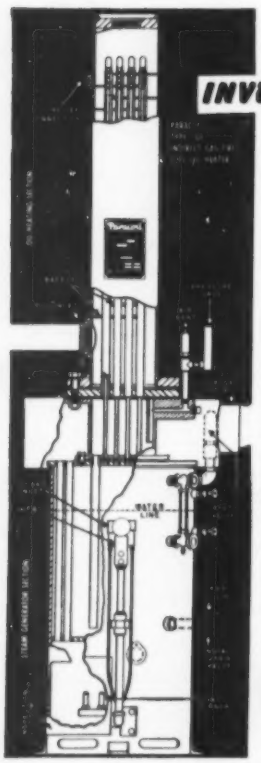

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of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature providing further information. Goulds Pumps, Inc.

226 Controlled Volume Pumps — Bulletin 351, 16 pp, describes company's air-powered controlled volume pumps, designed to pump practically any liquid in measured volumes accurate to within a fraction of 1 per cent. Pumps are reciprocating, positive displacement plunger types. Cross-sectionals show design and operating details. Controls and typical automatic feed systems are discussed. Milton Roy Co.

227 Rotary Pump Service Manual — The installation, operation and maintenance of rotary pumps are covered in 12-pp Service Manual 100-2. Subjects discussed include installing of foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation and standing idle. Warren Steam Pump Co.

228 For Controlled Volume Pumping — Bulletin 300, 24 pp, describes Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a feeder, meter, instrument, filling machine, proportioner and sampler. Process Equipment Div., Lapp Insulator Co., Inc.

229 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data and vapor pressure tables included. Pacific Pumps, Inc.

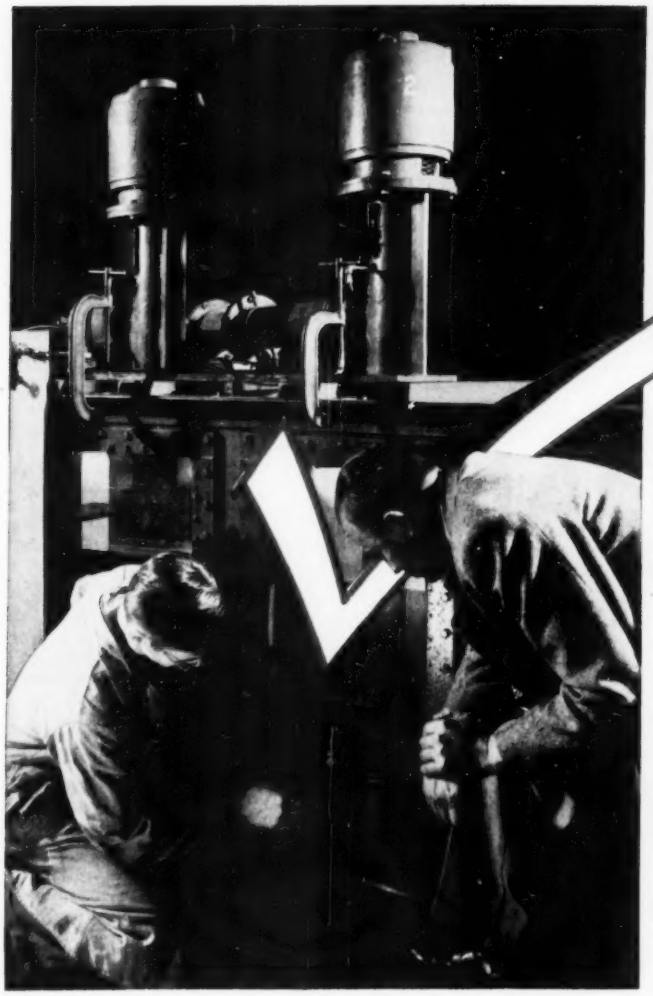
BOILERS, GENERATORS

230 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data, and dimensions and standard and accessory equipment for the units which range from 20 to 6000 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

231 Shop-Assembled Boiler — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed. Capacities, dimensions and weights given. The Babcock & Wilcox Co.

232 Re-circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or where load fluctuates. Combustion Engineering, Inc.

233 Steam Generators — Twenty-pp Bulletin SB43, 20 pp, describes company's VL factory assembled generators



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combining 2-drum water-tube boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Use of generator with various fuels and firing arrangements is covered. Erie City Iron Works.

234 Steam Boilers — Form SG 128-749 is a 12 pp catalog illustrated with photos of steam boilers for processing and heating, ranging from 15 to 500 hp and 15 to 200 psi. Includes diagrammatic cross-section of four-pass design characteristic of company's boilers. Cleaver-Brooks Co.

235 Scotch Marine Boilers — Bulletin 236 illustrates and describes a Scotch type of boiler on skids suggested for a wide range of applications. This boiler can be hand- or stoker-fired with coal or can use oil, gas or wood as fuel. Gives construction details, stresses versatility, other advantages. Includes test data and specifications. The James Leffel & Co.

236 Oil or Gas Fired Automatic Boilers — Boiler, burner, controls and safety features of 10 to 500 hp oil or gas fired automatic boilers are described in this bulletin. Firing rates, dimensions and capacities are given for all models along with installation photos of some models. Boiler Engineering & Supply Co.

HEAT EXCHANGING, COOLING

237 Heat Exchangers — The advantages of film-type heat exchangers in the solution of cooling water problems, even when dirty water must be used, are stressed in Bulletin HE-7, 8 pp. Explains and illustrates design details. Discusses use of these heat exchangers in power plants, chemical plants, and in a compression plant. Henry Vogt Machine Co.

238 Finned Tube Heat Exchanger — Bulletin 1400, 20 pp, fully describes the company's G-R Twin G-Fin Section heat exchanger. The unit has wide application for heating and cooling liquids and gases, and for condensing vapors, according to the company. Suitable as boiler feedwater preheaters, fuel oil heaters, etc., features of design and construction are given. Griscom-Russell Co.

240 Air-Cooled Heat Exchangers — Technical Bulletin R-53-DC1 is a 6-pp illustrated article on the economics of the air-cooled heat exchanger for process cooling. Discusses air-cooled exchangers and their selection, gives design details that affect cost and evaluates operating costs. The Marley Co.

TUBING AND ACCESSORIES

241 Condenser Tubes — Excellent information on condenser tubes and their service life is given in this 40-pp illustrated booklet. Subjects discussed include corrosion of condenser and heat exchanger tubes, corrosion resistance and control, the selection of tube materials, and the composition and physical properties of company's alloys. Details on proper installation are presented, as are specifications, conversion tables, weights of tubes and alloys. Scovill Mfg. Co.

242 Life Extension for Condenser Tubes — This 32-pp extensively illustrated booklet reports on research into the causes of corrosion and means of combating them, as well as the choice of condenser tube materials. Points out that Admiralty metal, long a standard for power plant condenser tubes, works satisfactorily in most installations, but other alloys may be necessary in some circumstances. Revere Copper and Brass, Inc.

Postage-free cards for ordering these catalogs are on pages 35 and 114. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address

243 Nickel Pipe and Tubes — Bulletin T-17 is a 27-pp technical bulletin on the fabrication and design of nickel and high nickel alloy pipe and tubing, illustrated throughout by drawings and photos. Presents tables on mechanical and physical properties, ASME code requirements, recommended welding procedures. The International Nickel Co., Inc.

244 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

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245 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators presented. Thomas C. Wilson, Inc.

246 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads discussing special features. Roto Div., Elliott Co.

247 To Avoid Tube Corrosion — Bulletin TR-514 is an 8-pp illustrated article discussing corrosion as a major factor in shortening the life of boiler tubes. Indicates that, in low pressure boilers, corrosion is the largest single cause for replacement of tubes. Points out types and causes of corrosion and gives general rules to follow to get maximum service life from boiler tubing. Tubular Products Div., The Babcock & Wilcox Co.

GAS AND OIL BURNERS

248 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each. Coppus Engineering Corp.

249 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

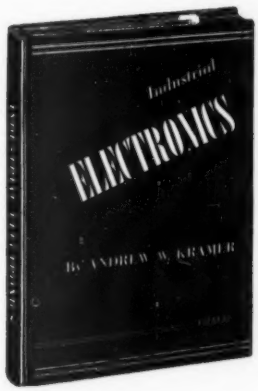
250 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc.

FUEL OILS, LUBRICANTS

251 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

252 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, also safety precautions. Cities Service Petroleum, Inc.

253 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is covered. Sinclair Refining Co.



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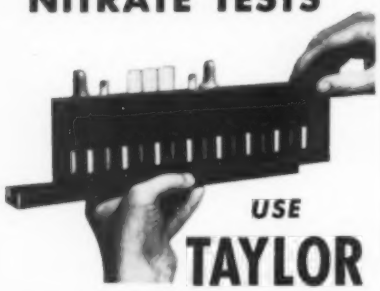

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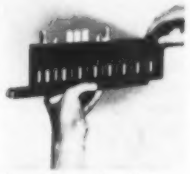

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254 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

255 Turbine Lubrication — The special problems of turbine lubrication are discussed in 8-pp Bulletin TU-1. Tells how purifiers keep power units in service; discusses inhibited and uninhibited oils, company's process for reducing sludge formation within lubrication system. Illustrated with diagrams of typical installations, photos of purifiers. DeLaval Separator Co.

COAL, ASH HANDLING

257 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

258 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated with action photos; picture several models. Tractor Div., Allis-Chalmers Mfg. Co.

260 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

262 Automatic Coal Scale — Sixteen-pp Bulletin 0352 describes an automatic coal scale for weighing coal as it is fed to boilers, enabling a power engineer to maintain a constant check on boiler efficiency. Book gives construction and operating details on the belt feeder, weigh hopper, scale housing, operating levers and accessories. Photos and line drawings show scale features. Richardson Scale Co.

263 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

INSTRUMENTS AND CONTROLS

264 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

265 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical in-

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1 — General Electric Curtica Steam Turbine, 3000 KW, Speed 3600 RPM, Form G, No. 12102, Pressure 250 lbs.

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1 — Combustion Engineer boiler for above Turbine Unit, Rated 750 HP, Pres. 250 Pounds, 125 Suf. Heat. With 3 Units, Detroit Roto Stokers, Motor Driven. Motor Model — 5K254A210, Frame 254, Type K, 220-440 Volts, 60 Cycle, Phase 3, 8.78/4.39 Amps., Speed 1165 RPM, 3 HP, No. HM2768. All auxiliary equipment for the above units.

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1 — B.&W. Boiler rating 560 HP, 125 Deg. Suf. Heat, 250-lb. Pressure, 2 type E. Stokers. Forced draft fan. Motor, G.E. Model 9437, Type KT332-6-40-1200, Form B-3 Phase, 60 Cycle, 440 Volts, 48.5 Amps., Speed 1145, No. 3952606. Induced draft fan Motor, Westinghouse; Style We 160821A, Type C.S., Model No. 2315748, 440 Volts, 59.2 Amps., 25 HP, Speed 1150.

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sulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester, justifies cost in long run economy. James G. Biddle Co.

266 Industrial Thermometers — Catalog 125, 28 pp, presents ordering data on a wide range of industrial thermometers, giving scale ranges, dimensions and prices. Features company's Adjust-Angle thermometer designed for use at any angle front to back, left or right, through a 180 deg arc. Gives construction details and advantages of this adjustable-stem type instrument. Weksler Thermometer Corp.

267 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.

268 Sight Glass Flow Indicators — Twelve-pp Bulletin 18-W, on company's line of flow indicators, shows how these mechanical devices indicate fluid flow and its direction in pipelines which can be directly observed through a sight glass and are suitable for service with liquid, gas, vapor, slurry or sludge sufficiently translucent to permit observation of indicating element. Schutte and Koerting Co.

269 How to Select Regulators — This 36-pp, illustrated "step selection chart" simplifies choice of proper type and size of pressure regulator, temperature regulator or pump governor to do a specific job. Written in nontechnical language and supplemented by steam, gas and water capacity tables, this booklet includes installation suggestions, conversion tables and other data. Foster Engineering Co.

270 Steam Specialties — Catalog 53, 62 pp, describes a line of steam, gas, air, oil and water regulating equipment. Includes complete specifications, operational data and prices on pressure regulators, temperature regulators, combination pressure-temperature instruments, diaphragm valves, motor operated valves, float valves, safety and relief valves, strainers, solenoid and motor valves, water gages. Provides capacity tables, flange charts. O. C. Keckley Co.

271 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

272 Supervisory Instruments — Catalog 90-2. "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

273 Boiler Control — Ten-pp Bulletin 1007 describes a completely integrated system for controlling combustion, feedwater, boiler steam temperature and boiler cleaning, available in a single package or furnished separately. Illustrated with full

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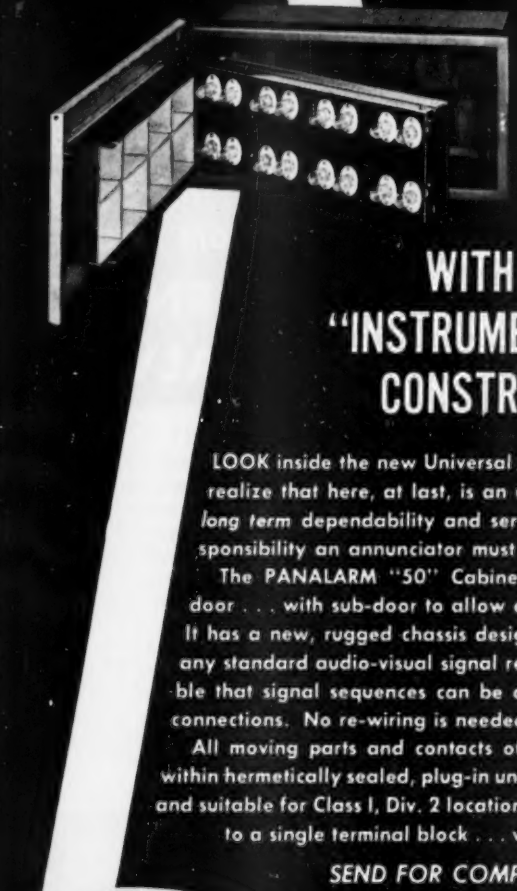

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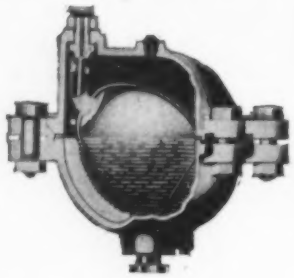

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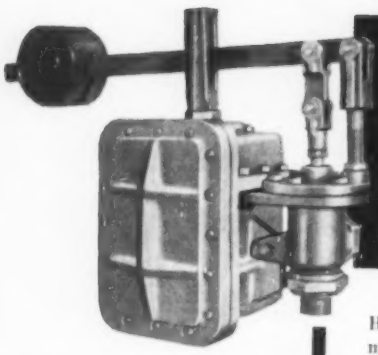

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color drawing of complete control, photos of recorders, drive unit. Covers instrumentation with both miniature and standard instruments. Copes-Vulcan Div., Continental Foundry & Machine Co.

274 Panel Planning Ideas — The engineering and economical planning of modern combustion and process control panels is discussed in 8-pp Bulletin 170. Numerous panel designs, fashioned for control, are illustrated along with the most up-to-date methods of tubing and wiring. A section on accessories helps make this a valuable source book of ideas for control station planners. Bailey Meter Co.

275 Control Centers — This 31-pp application booklet (B-5621) on control centers stresses the case for centralizing all controls of an entire system in one group of enclosures. Discusses the characteristics of control centers that make for flexibility of use, ease of servicing, safety. Three types are described, and the various electrical components that make up typical units are illustrated. A three-step building-block system of planning control centers is given. Westinghouse Electric Corp.

277 Control Equipment — Catalog 003, 32 pp, presents company's equipment for the control of liquids and gases for water and sewage works, power and process industries. A well illustrated booklet, it lists many types of controllers, gages, manometers, valves, venturi tubes. Descriptions of the units, their operating characteristics, construction details, mountings, specifications and other data included. Simplex Valve & Meter Co.

278 Pressure Regulator — Bulletin 1-B, 8-pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for back pressure relief valve. Atlas Valve Co.

WATER CONDITIONING

279 Water Conditioning Data Book — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

280 What's What on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

281 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and feedwater system, condensate returns. % Proportioneers, Inc. %

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282 Modern pH and Chlorine Control — This 100-pp booklet gives details in color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; feedwater. W. A. Taylor & Co.

283 Boiler Scale — Formation and Prevention — Technical Paper 98 is a 12-pp article covering the cause and prevention of boiler scale. Covers the mechanism of scale formation, effect of boiler scale, chemistry of scale formation, internal chemical treatment and chemical correctives. Diagrams of feeder systems, photos and solubility charts illustrate text. W. H. & L. D. Betz.

284 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Hall Laboratories, Inc.

285 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

286 Treatment by Ion Exchange — Methods of ion exchange treatment and its general and special applications for water and other liquids are explained in 8-pp Bulletin A. Discusses manufacturers' deionizing equipment as to construction and

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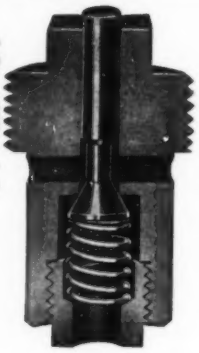

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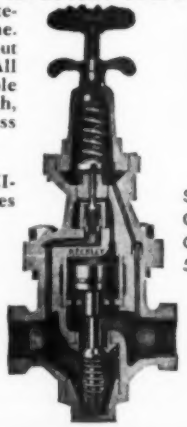

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operation, pictures applications. Illinois Water Treatment Co.

287 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blow-down adjustment, test control. Describes equipment. Dearborn Chemical Co.

288 Microbiological Control — Technical Article 3C, 12 pp, is an illustrated discussion of microbiological control of and through industrial waters. A section on industrial water chlorination covers cooling waters and process waters. Other sections deal with chlorine metering in chemical processes, and the sanitary aspects of industrial water treatment. Wallace & Tiernan Co., Inc.

PACKINGS, GASKETS, SEALS

289 Seals for Bearings — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

290 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

OTHER EQUIPMENT

291 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs. practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases, CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. The Hays Corp.

292 Turbine Generators — Bulletin H-18, 40 pp, covers turbine generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical installation arrangement. Elliott Co.

293 Motorized Chimney Draft — The advantages of mechanical draft in supplying positive, uniform, adequate draft, regardless of variable weather conditions or inadequate chimney or breeching construction are shown in detail in Bulletin I-52. Also discusses other advantages, including eliminating need for tall stacks. L. J. Wing Mfg. Co.

Postage-free cards for ordering catalogs and bulletins are provided on pages 35 and 114

294 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

295 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. The Green Fuel Economizer Co., Inc.

296 Feedwater Heating System — This bulletin describes a flash-type deaerating feedwater heating system offering flexibility in the use of steam at different levels. The Whitlock Mfg. Co.

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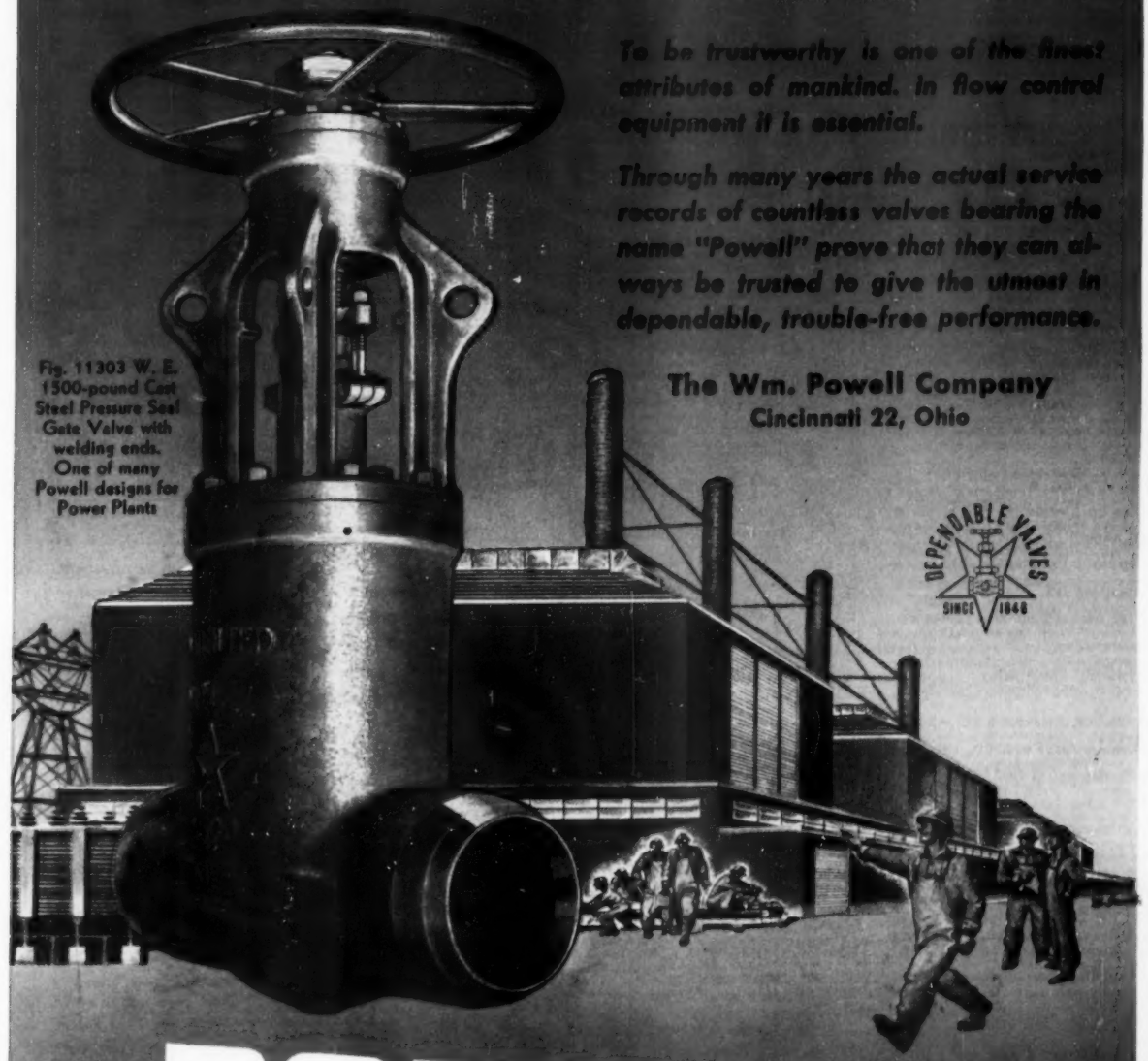

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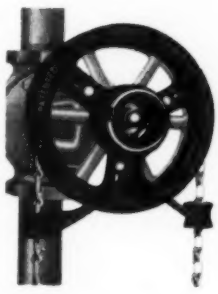
Buy U. S. Savings Bonds!

Protect Your Manpower with...

Babbitt *Adjustable* SPROCKET RIM *with Chain Guide*

Control out-of-reach overhead valves right from the floor! No more climbing on ladders, balancing on boilers, perching on workbenches or machines. Prevent accidents and costly claims — also save fuel, steam and money.

Only four simple, quickly-assembled parts installed and operating in only a few minutes, Babbitt Adjustable Sprocket Rim with Chain Guide —



- **Fits all valve wheels**
- **Simplifies pipe layouts**
- **Eliminates risky climbing**

Range of 10 adjustable sizes fits all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

Call your Industrial Distributor. He carries complete stocks.
Or write for descriptive folder and prices.

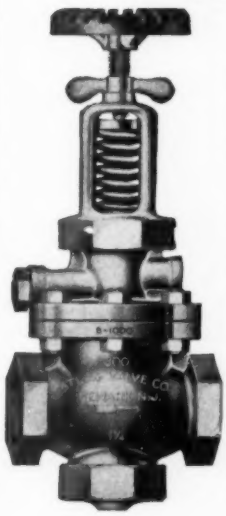
Babbitt STEAM SPECIALTY CO.

4 BABBITT SQUARE, NEW BEDFORD, MASSACHUSETTS

For more data circle 569 on Post Card

STELLITED ATLAS

Steam Reducing Valves Type "B"



In our 52-page bulletin 1-A ten pages are devoted to ATLAS Type "B" Reducing Valves. Fig. 112, shown here, is a bronze body reducing valve for 300 pounds steam service. For reduced working pressures from 10 lb. to within 20 pounds of the initial pressure in one stage.

Fig. 114 has an iron body. For initial working pressures from 20 to 250 lb. saturated steam. Reduced: same as Fig. 112.

Fig. 112 (LP) is similar in most ways to Fig. 112 but handles reduced working pressures of ½ to 15 lb.

Fig. 114 (LP) has an iron body. Similar to Fig. 114 but handles reduced working pressures of ½ to 15 lb.

Then come the steel bodies—right from Series 15 to Series 90, for all the way up to 900 lb. pressure with 900° F temperature. Some of them handle reduced working pressures from 10 lb. to within 30 pounds of the initial pressure in one stage and the others handle reduced working pressures from ½ lb. to 15 lb.

ALL ARE STELLITED

The pilot valves are solid Stellite. The pilot valve seats are Stellite faced. In the steel body valves the main valve seat is solid Stellite. Stellite assures long life because it is practically immune to severe abrasion and corrosion.

Type "B" valves are recommended for reducing the pressure of steam where the service demands a tight seating valve and a uniform reduced pressure. Simple to maintain. Main valve and pilot valve are easily removed for cleaning. Entire pilot valve can be lifted out without difficulty.

To get the whole story — cross sectional views — details as to parts — etc. — together with information concerning other ATLAS Reducing Valves for steam, water, air, gas, or oil: —

Ask for Bulletin No. 1-A

ATLAS VALVE COMPANY

REGULATING VALVES FOR EVERY SERVICE

293 SOUTH STREET **NEWARK 5, N. J.**

Represented in Principal Cities

Campbell Boiler Feed Regulator	Exhaust Control Systems	Pump Governors
Damper Regulators	Back Pressure Valves	Balanced Valves
Temperature Regulators	Float Valves	Control Valves
	Pressure Regulators	Oil Control Cocks

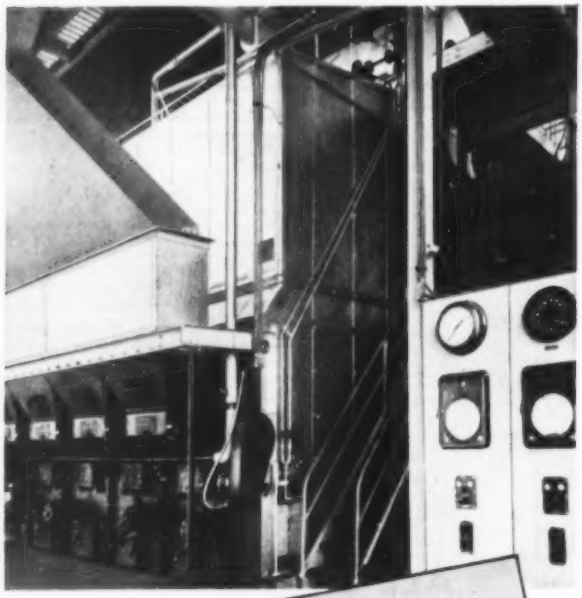
For more data circle 570 on Post Card

"HOW WE SAVE MORE THAN $90,000 A YEAR—

BY BURNING COAL THE MODERN WAY!"

says W. H. FISHER, Plant Engineer, Kerr Bleaching and Finishing Works, Concord, North Carolina.

"Powering our plant used to take nine boilers—now *one* does the same job *using 30% less fuel!* 6 firemen now do the work of 18—thanks to modern coal-handling equipment and automatic controls. That's why we say, you can't beat bituminous coal burned with modern equipment."



Above is a view of the plant's modern, space-saving coal-storage silo. To the left is a close-up of the firing aisle, showing the spreader stoker and the main control panel. Coal handling is automatic and dust-tight throughout. Automatic controls regulate firing, drafts and feed-water—give maximum efficiency at lowest cost.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U. S. A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

Burning coal the modern way can save *you* money, too! First, labor costs can be cut to a minimum with up-to-date coal- and ash-handling equipment. On top of that, today's combustion installations give you 10 to 40% more power from each ton of coal than was possible a few years ago!

If you're planning to modernize, or if you're building a new plant, call in a consulting engineer. He'll show you how you can get big savings by burning coal in a modern plant designed to meet your *specific* needs.

America's coal reserves are virtually inexhaustible; America's coal industry is the world's most productive and efficient. That's why coal has a future dependability of supply that no other fuel can offer. That's why, of all fuels, the price of coal is most likely to remain stable.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!

For more data circle 571 on Post Card

RUGGED BOSS

for Valves, Sluice Gates and Floorstands...

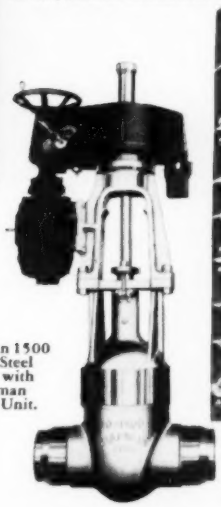
CHAPMAN'S

Motor Unit

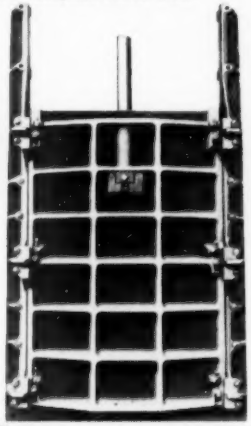
Above, Floorstand equipped with Chapman Motor Unit, Control Panel, Motor, Limit Switch and Push Button Station all completely wired. At left, Interior Mechanism of Chapman Motor Unit.

For positive control of large valves and sluice gates, the Chapman Motor Unit can safely be given your "power of attorney." The floorstands with Chapman Motor Units come to you with all wiring *complete*, so that all you have to do is bring the power leads into the connection box... which speeds up installation, insures proper operation, and saves wiring costs.

The Chapman Motor Unit is completely housed and thoroughly weatherproof. And the unit itself has the ruggedness of simplicity, with a slow-speed motor driving direct through two trains of spur gears. So there's no drift. The limit switch can be adjusted so the gate or valve closes to the exact seating position. Hand-operated, too, if the need arises. See what this modern electrically driven Motor Unit can do — *and save* — for you. Write for Catalog No. 50.



Chapman 1500 Series Steel Valve, with Chapman Motor Unit.



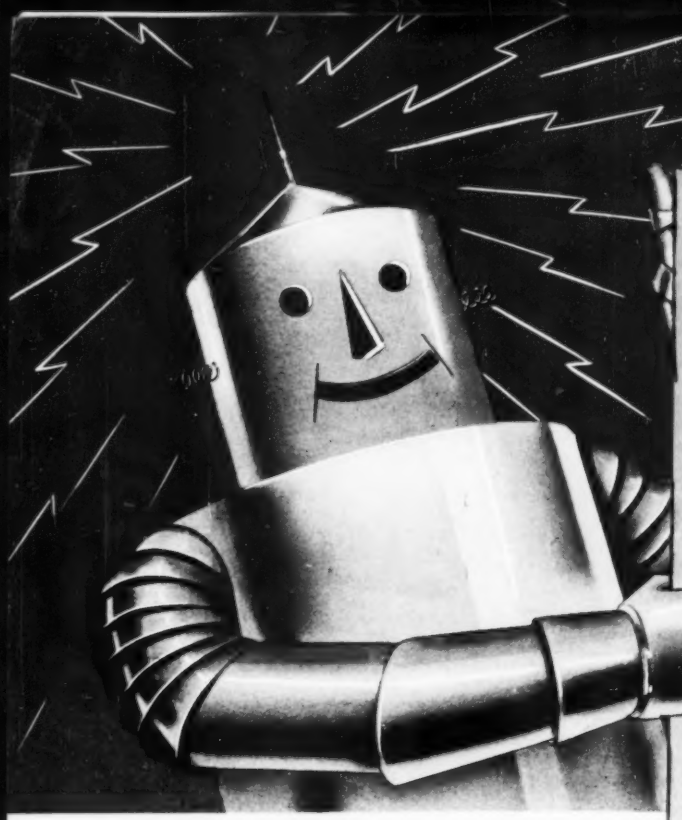
Chapman Standard Sluice Gate, with stem connection for Chapman Motor Operated Floorstand.

The CHAPMAN VALVE Mfg. Company

INDIAN ORCHARD, MASSACHUSETTS, U. S. A.

For more data circle 572 on Post Card

July, 1953



AUTOMATIC

Demineralization and Silica Removal by Ion Exchange Resins

MOTOR and diaphragm-operated valves make regeneration of Permutit Demineralizers fully automatic. This gives more positive control . . . eliminates the possibilities of costly errors . . . saves valuable man-hours formerly spent in regeneration.

In a recent installation for a 1450 psi boiler, two compact Permutit units fill all make-up requirements, regardless of changes in turbine loads . . . deliver a continuous supply of demineralized, silica-free water. What better way to eliminate scale and silica deposits!

HIGHEST PURITY MAKE-UP

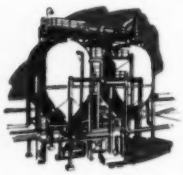
Effluents of Permutit Demineralizers have contained *total* electrolytes as low as 0.01 ppm and silica as low as 0.01 ppm! These values may be slightly higher under service conditions. In comparison, most distilled water contains 20 to 100 times more electrolytes . . . yet costs much more to produce.

INFORMATIVE NEW BULLETIN

You'll want this interesting book. Flow diagrams, illustrations and specifications explain key methods of demineralizing water and removing silica by ion exchange. Write for your copy, today!

THE PERMUTIT COMPANY, Dept. PE-7, 330 West 42nd Street, New York 36, N. Y., or the Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal, P. Q.

OTHER BASIC WATER CONDITIONING PROCESSES



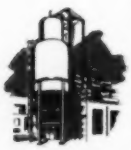
◀ Sludge Blanket Hot Lime Soda

Full utilization of Permutit sludge-blanket principle assures high efficiency. Reduces hardness to region of 20 ppm . . . silica to 2.0 ppm. Lowers alkalinity . . . removes wide variety of solids.

Hot Zeolite—Permutit Q ▶

Permutit Q—a styrene base resin resistant to high temperatures and pH values—replaces second stage phosphate treatment in hot-process softener. Results—residual hardness is completely removed at great savings in phosphate costs.

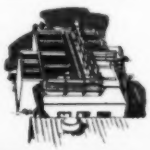
◀ Deaerating Heater



Removes objectionable oxygen and CO_2 to prevent corrosion and pitting of feed lines, stage heaters, economizers, and boilers at high temperatures. Steam is used twice . . . deaerates water completely.

Precipitator ▶

Softens water on space and time-saving sludge-blanket principle. Simultaneously removes turbidity, color, fluorides, reduces silica and lowers alkalinity.



PERMUTIT

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS